ELECTRICAL REVIEW

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Power Storage

AMPLIFICATION of reservoir capacity for meeting the heavy day demands on hydro-electric stations has for some years been obtained abroad by pumping up water at night from lower levels. The economic comparison is mainly between the cost of providing greater storage, plus possibly more or larger generators, and the cost of pumping plant and low-level pools, which is incremental to relatively heavy expenditure already incurred on the main scheme and might well be justified, for example, for certain Highlands projects.

A possible variant for application to thermal stations was suggested by Mr. T. G. N. Haldane in his presidential address to the Association of Supervising Electrical Engineers. In this case the whole cost of high- as well as low-level reservoirs, hydraulic turbo-generators and electrically driven pumps would have to be debited to the pumping scheme. Then the fixed and running charges on new steam turbo-alternators would be set against corresponding charges on pumping plant and low-level storage and any transmission required, including losses amounting to over 30 per cent.

Under present conditions the daytime peak is borne by low efficiency stations retained only because of the shortage of generating plant. The coal saving per kWh by using pumped storage and, in effect, transferring the peaks to the highly efficient base load stations at night, might well be more than enough to offset the cost of pumping systems. This difference would, however, be less marked in a few years time when more modern plant is in commission. Full allowance should be made for the lower rate of depreciation on a substantial proportion of the pumping scheme that is of a long-life civil engineering nature. Account should also be taken of the elimination of boilers and other plant which makes a call on over-taxed manufacturing resources. There might also be some fuel saving through the use of water resources too small for serving normal hydro-electric stations. Pumped storage presents the only

means now apparent of storing electricity, albeit indirectly, in the generation process on an appreciable scale. In Mr. Haldane's view an expenditure on pumped storage of up to £50/kW, including transmission, would be worth while under suitable conditions. Present indications are that, while the scope for pumped storage in connection with steam stations may be restricted, there are sites in hilly districts that present a prima facie case for detailed investigation.

CONGESTED CONVENTION

The preliminary programme for the British Electrical Power Convention at Bournemouth discloses that although the period has been substantially curtailed the amount of matter to be dealt with is greater than ever before. At the first of the two afternoon sessions seven papers on research are to be presented (we can hardly say " read ") and there are to be five papers on the second afternoon. This gives each author very little time and the president will be hard put to it to keep to the time-table. Discussion will be severely limited although the subjects are such that the views of many people would be interesting and valuable. It would almost seem that the Council has set out to convince the delegates (by exhaustion) that its decision to shorten the Convention was a wrong one.

COGENT TOPICS

Having said this we have to admit that the choice of subjects for the papers is excellent and calculated to appeal to all the branches of the industry represented in the Convention. Research is recognized as the principal path by which this country can maintain its leadership in technical advance. Sir Arthur Fleming and the authors of the other papers are well qualified to deal with the various aspects of research which are being discussed. The same is true of the batch of papers on what appear to be various forms of domestic load. This is a subject upon which a good deal of the industry's " bread and butter " depends and it is to be hoped that the authors will prove convincingly that the domestic use of electricity is essential and beneficial and not anti-social as some " authorities " profess to believe.

NATIONAL RESEARCH

Quite a number of private inventors appear to misunderstand the functions of the National Research Development Corporation, whose second annual report is mentioned on another page. The object is not to provide working capital to enable patentees to set themselves up in business with a view to selling something which industry, or the public, appears to be reluctant to buy. What the Corporation is endeavouring to do is to pay for such development as may be necessary to give practical embodiment to immature but fertile ideas which it considers to be of sufficient public importance. It is working along the lines of demonstrating a fully engineered prototype to " a firm engaged in the industry concerned " in order to prove that the invention is a sound one.

WIDER USE OF ALUMINIUM

Because of the serious copper shortage American Governmental agencies have been pressing manufacturers to use aluminium wherever possible. Electrical manufacturers have responded well to this call—so well that some of their number fear that they may have gone too far in some directions especially as an aluminium scarcity seems to be possible. A number of cable makers are producing insulated aluminium conductors and they report success. The use of aluminium is also reported for lamp caps, small motor windings and even for transformer coils. Research is also being pursued into the use of the light metal for the windings of large motors and generators.

Plant and Processes at the Abbey Works of the Steel Company of Wales

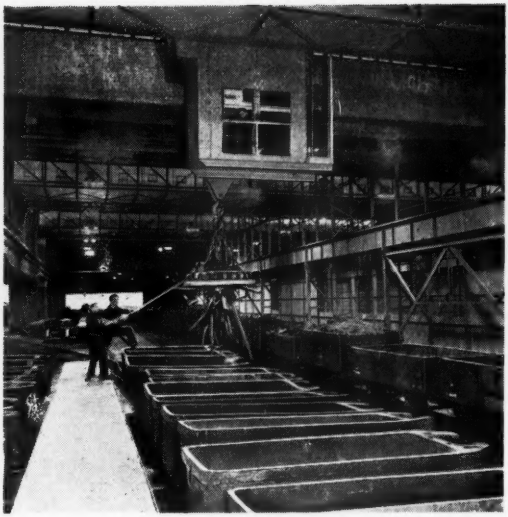
IN the *Electrical Review* of 21st December, 1951, in which the new blast furnaces in the Margam section of the new steel works of the Steel Company of Wales, Ltd., Port Talbot, were dealt with, we followed the main production line up to the delivery of molten pig iron in 75 ton Kling ladles to the Port Talbot, Margam and Abbey melting shops.

To follow the major production line through the next group of processes we now deal with the Abbey melting shop. This shop, about a mile south of the blast furnaces, is about 1,500ft long, running almost due north and south. On the west boundary of the shop is the scrap box filling bay, and then from west to east there are the charge holding bay, the furnace bay, the casting bay, and finally the mould preparation shop which is a separate building.

Under the charge holding bay and the furnace bay there is a basement in which there are waste heat boilers through which the flue gases from the open hearth furnaces pass on their way to the chimneys, together with the waste heat boiler fans, dampers and other auxiliaries.

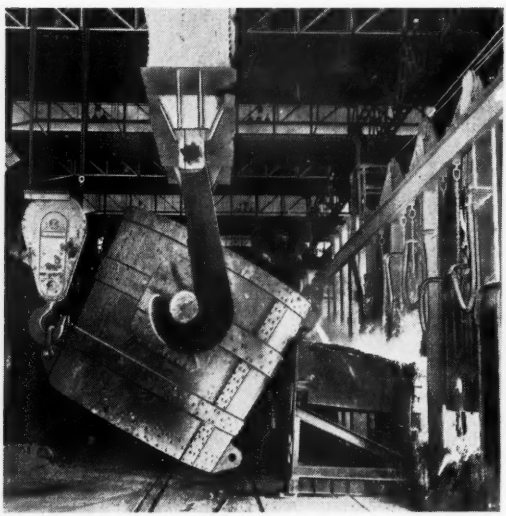
The floor level of the basement is 21ft O.D., while that of the charge holding and furnace bays is 43ft. The average height of the building is 80ft, but at the mixer section at the north end of the furnace bay the roof rises to a maximum height of 110ft, so as to permit pouring into the mixers from the Kling ladles with the ladle crane suspended and tilted at a high level above the mixers.

The molten pig iron, however, is merely one of the raw materials for the actual steel making, for at the south end of the shop is an extensive system of railway sidings which serve largely for the delivery of another major raw material—scrap—to



The railway trucks of scrap hauled by diesel-electric locomotives can go straight to the scrap box filling bay for off-loading into a storage bunker or furnace charging boxes

Charging of the open hearth furnaces with molten pig iron is carried out at intervals by 135 ton cranes spanning the furnace bay

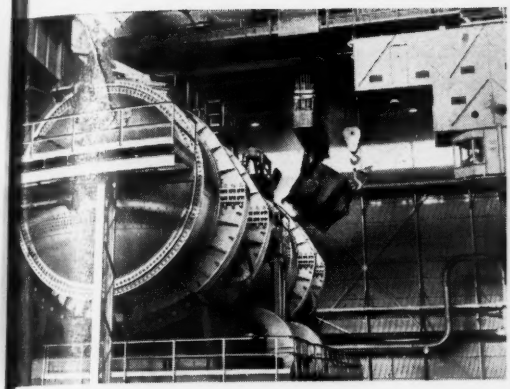


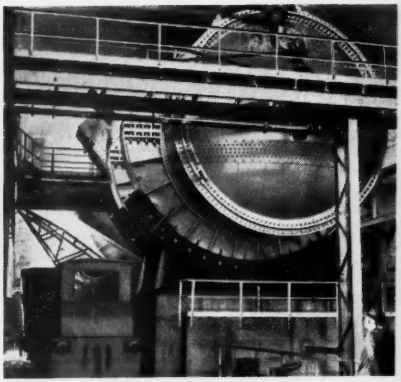
the stocking area at the same end of the melting shop. The scrap is off-loaded to the storage ground where, after inspection, it is picked up as required by magnets suspended from caterpillar tracked cranes and placed into other wagons as required. These wagons are then hauled by diesel-electric locomotives up a ramp to the 23ft floor level of the scrap box filling bay. Here the scrap is either unloaded into a storage bunker which constitutes an immediate reservoir for serving the open hearth furnaces, or it is loaded into the open hearth furnace charging boxes direct.

The charging boxes, each of which is about 7ft long, 2ft 3in to 3ft wide and 2ft 3in deep, are placed on bogies, four charging boxes per bogie, and each bogie has an automatic centre coupling of the buck-eye type.

Alternatively the railway trucks of scrap, instead of being passed to the scrap storage ground, can go straight to the scrap box filling bay for off-loading either into the storage bunker or directly into the charging boxes. After loading, trains of bogies are shunted into the charge holding bay, and from there they are passed into the furnace bay as required, the trains first being lined up immediately in front of the furnaces ready for the charging boxes to be picked up individually by one of the 10 ton non-slewing type ground chargers for deposition of the box contents directly into the furnaces. The shunting of the trains of bogies between the charge holding bay and the furnace bay is shared by diesel locomotives and the ground chargers.

Charging the open hearth furnaces with molten pig iron is carried out at intervals, following the scrap charging





Left: **Molten pig iron is poured into the gas fired 800 ton mixers which are tilted under their own power.** *Right:* **Iron from the mixers goes into ladles which are handled by an electric locomotive**

operation, by means of 135 ton cranes spanning the furnace bay. The molten pig iron is poured into 800 ton molten metal mixers in which the metal is maintained at its correct temperature by means of coke oven gas firing.

When required the molten pig iron is poured from either of the mixers which are tilted under their own power into hot metal ladles which are handled first by an electric locomotive and then by one of the 135 ton cranes for pouring directly into the furnaces through separate hot metal chutes which are previously placed by any of the ground furnace chargers. Although molten pig iron and scrap are

Left: **The open hearth furnaces are tapped in the casting bay into 200 ton ladles; smaller ladle for receiving slag.** *Right:* **The 200 ton ladles are handled by 300 ton cranes spanning the casting bay (note long suspended turret): teeming operation**

For steel recovery in the slag yard, cranes are used on two levels

the two main raw materials for the production of steel, the production or shop term " raw materials " also includes such materials as limestone, ferro-manganese, dolomite, iron ore, etc., which are stored in a raw material bay situated on the west side of the scrap box filling bay. There are two levels here, i.e., 21ft O.D. and 43ft O.D. The 43ft level is the same as that of the scrap box filling bay, and trucks of these materials are shunted up a ramp to this level in similar fashion to the shunting of the trucks containing scrap to the scrap box filling bay.

From the higher level the bottom discharge trucks are off-loaded into bunkers. Bogies loaded with charging boxes are shunted into the raw material bay and the boxes are filled by means of grabs operating from overhead cranes. In the raw material bay are crushing and grinding plants for dealing when necessary with materials for the masonry department, etc. Other raw materials follow the same route to the furnace bay as the scrap boxes.

There are eight 200 ton open hearth furnaces, each with a refractory lined bath about 52ft long, 16ft wide and 2ft 8in deep. Each furnace is oil fired, the direction of firing being reversed periodically. The flue gases from the furnace chamber pass first one way and then the other way through the honeycombed brickwork chambers underneath the furnace proper, so as to permit heating of the incoming combustion air on the regenerative principle.

The furnaces are tapped in the casting bay on the east side of the furnace bay, i.e., at the back of the furnaces into 200 ton ladles suitably placed on the 21ft basement level, so that they receive the molten metal from the furnace tapping holes. In each case a 30 ton ladle or slag pot is placed beside the large ladle, so that as the latter fills up the slag on top of the metal in the larger ladle overflows at a suitable outlet into the smaller vessel.

After filling, the molten steel is teemed through a nozzle in the bottom of the ladle into ingot moulds which have been previously prepared and positioned on a train of bogies on the other side of the casting bay. Spanning the casting bay for handling the 200 ton ladles are what are believed to be the highest capacity travelling cranes in Europe, namely, three Adamson Alliance 300 ton equipments.

The slag is transported to a yard 400 yd or so seaward of the main melting shop building, where a proportion of steel is recovered from the slag. In this process cranes are used on two levels for raising material by suspended magnets, and for handling a crushing ball in similar manner within a crushing pit.

After filling and cooling, the train of ingot moulds is shunted into an ingot stripping bay ready for the first process, to be dealt with in our next article which will describe the electrical application to the hot slab rolling processes.

The foregoing outline of the melting shop plant layout and processes provides a background for the following account of the various electrical drives. It will be seen that, electrically, the cranes loom large in the melting shop and so we will deal with all the cranes at this stage.

In the raw material bay there are two 10 ton/10 ton double hoist cranes with moving cabs. The long travel is served by a [illegible] h.p. motor. The cross travel motor is of [illegible] h.p. and is equipped with a shunt brake and each of the hoist motions is served by a [illegible] h.p. motor and has a series brake.

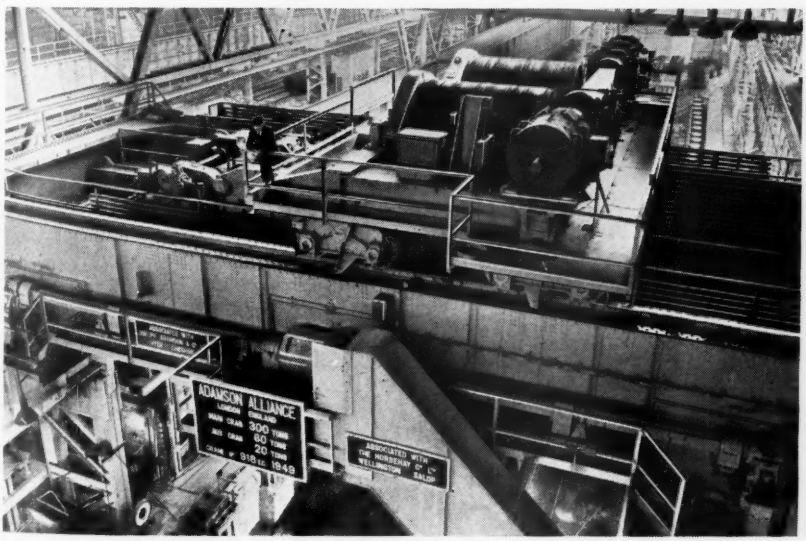
In the scrap box filling bay each of the present three 10 ton moving cab cranes has long travel, cross travel and hoist motions served by 75 h.p., 25 h.p. and 75 h.p. motors, respectively. Each of these cranes is fitted with a 440 V, 65in diameter Allen West magnet, but provision is also made for the use of 220 V, 55in diameter Igranic magnets.

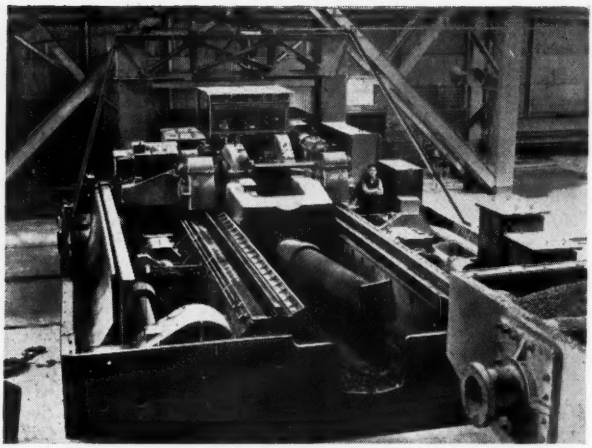
Each 135 ton crane in the mixer and furnace bays has long travel motions served by two 100 h.p. motors which, although electrically and mechanically independent, have a common controller. In each case there are both main and auxiliary traverse motions served by 50 h.p. and 15 h.p. motors, respectively, while each main hoist and auxiliary hoist of 135 tons and 60 tons is served by its own 100 h.p. motor. This peculiarity in respect of the motor sizes is explained by the fact that the 60 ton auxiliary hoist has a considerably higher working speed than that of the main hoist.

The very large cranes in the casting bay each handle a total weight of 300 tons when carrying a fully loaded 200 ton ladle. The overall weight of the crane and its load is over 600 tons. An unusual feature of these cranes is the long turret suspended from one side of the main overhead structure. This turret contains several storeys with staircase access; the lowest compartment, which is air conditioned and nearly all glazed, constitutes the driver's cab. The remainder of the compartments above serve as convenient chambers for housing the Igranic contactor gear, resistances, etc.

On each of the very large cranes spanning the casting bay there are two cross-travelling hoisting crabs. One of these crabs carries the main 300 ton hoist, while the other is equipped with two auxiliary hoists of 60 tons and 20 tons capacity, respectively. The cross travel of the main crab is driven by a 75 h.p. motor, while the hoisting motion has two 200 h.p. G.E.C. mill type motors, each of which is equipped with series and shunt brakes. The cross travelling motion for the smaller crab is operated by a 25 h.p. motor and the two auxiliary hoists are powered as follows: 60 ton hoist, 100 h.p. motor; 20 ton hoist, 75 h.p. motor. Each hoist has series and shunt

On each of the very large casting-bay cranes are two cross-travelling hoisting crabs





The chariot traverses the charger from back to front over a distance of about 16ft

brakes and is equipped with over-wind Palmer hoist limit switches.

The long travelling motion for the main crane bridge is provided by two 150 h.p. motors. These motors, apart from having a common controller, are not interconnected mechanically or electrically. Normally both long travel motors are in operation together, but each drive alone is capable of long travelling the loaded crane at a reduced speed. The traverse conductors on these cranes consist of flat steel rails, while the pick-up is provided by shoes which bear on the upper faces of the rails.

The slag yard cranes run at levels of 68ft and 44ft above the yard proper on an " open " girder structure; the span is 75ft. The two low level cranes which are used for handling the slag for steel recovery and disposal purposes are 50 ton equipments with 20 ton auxiliary hoists. The long travel, cross travel, main hoist, and auxiliary hoist motors are as follows: 50 h.p., 25 h.p., 100 h.p. and 75 h.p., respectively. The long travel motor is equipped with a shunt brake and the cross travel motor and both hoisting motors all have series brakes. Each crane is equipped with a 55in, 220 V Igranic magnet, but by means of resistance adjustment, 65in, 440 V Allen West magnets can be used.

The high level crane used for skull breaking is a 15 ton equipment, and its long travel, cross travel and hoist motions are powered as follows: 50 h.p., 25 h.p. and 100 h.p., respectively. The driving motors are equipped with brakes similar to those on the motors of the low level cranes. All the cranes except those in the mould preparation shop are of Adamson Alliance make, those in the mould preparation shop being Arrol equipments. Handling in the mould preparation bay is by means of 25 ton overhead travelling cranes, the long travel, cross travel and hoist motions being respectively served by 35 h.p., 7·5 h.p. and 75 h.p. motors.

There are many features common to all the cranes mentioned. The control gear, for instance, is of the Igranic " Conditle " reversing dynamic braking type. Timing is by condenser discharge across the hold-out coils at the bases of all the accelerating contactors, thus ensuring correct starting current steps for the motors which are all G.E.C. series mill type machines. The electro-magnetic brakes throughout are of Igranic make, and the hoist motions on the larger cranes have two motors driving on a single shaft with a series brake for each motor and a shunt brake for " parking."

The Igranic main hoist limit switches are of the Palmer safety type which, when tripped, afford dynamic braking in one direction, irrespective of voltage loss. Any tendency for the load to run away if the switch trips is countered by a resistance being thrown across the motor armature, thus converting the motor into a d.c. series generator.

Cranes working in " hot " areas such as the casting, mixer and furnace bays, have their cabs air cooled on the refrigerator principle. The down-shop conductor rails are of inverted V section, 3in by 3in by ½in, supported on insulators secured on channel iron section. The rails are sectionalized and fed at both ends. The crane collector shoes are of cast iron V section pivoted on a ball and socket arrangement.

The crane wiring throughout is Pyrotenax. The Igranic control panels are hinged in the crane contactor houses and are readily lowered to an angle of 45 deg for maintenance purposes. This is an excellent space saving scheme in the rather confined contactor rooms.

Mounted in the roof structures above the cranes are Vaughan and Morris repair trolleys for servicing the main cranes. On all the two-motored motions a single motor provides sufficient power to operate normal loads at reduced speeds.

In the charging bay there are three 10 ton Arrol-Morgan ground chargers which run on rails at 20ft centres throughout the whole length of the melting shop. The chargers are propelled or long travelled by two 75 h.p., 220 V, d.c. motors in series across a 440 V supply. Each motor serves a layshaft on either side of the charger.

Although these two motors operate electrically in series they are mechanically independent and constitute two separate power transmissions for long travelling. They are fitted with Igranic shunt brakes. The chariot, which traverses the charger from back to front over a distance of about 16ft, consists of a carriage on which is mounted the driver's operating cab together with the control gear and resistances for the following 440 V, d.c. series motors: traverse, 59 h.p.; rocking hoist, 75 h.p.; and bar turn, 35 h.p.

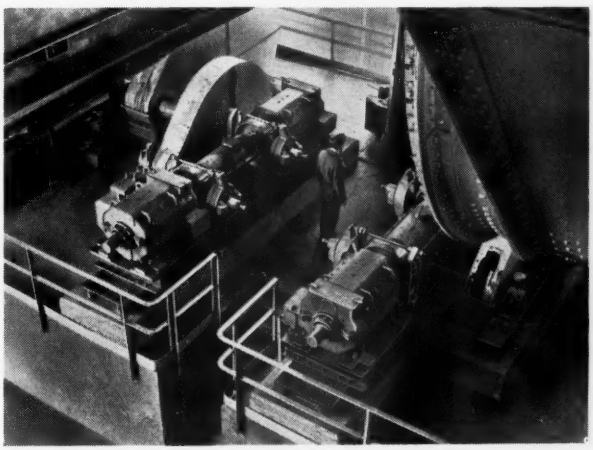
The rocking hoist travels laterally across the charger with the moving chariot, and the square end of the ram, which is slightly cambered, engages a corresponding "insert" at the end of the charging box and operates on a crank. As the box is lifted it is held fast on the end of the ram by means of a locking bar mechanically engaged from the cab. A continued forward motion of the chariot propels the ram holding the charging box containing scrap or limestone, etc., through one of the five doorways of each furnace.

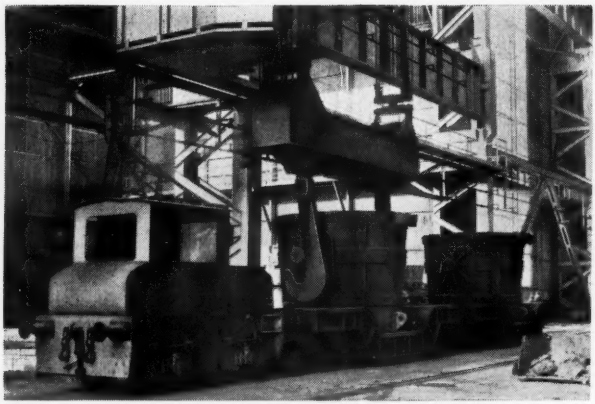
The 35 h.p. motor imparts a complete turn to the shaft, and thus to the box, so that the contents of the box are emptied into the furnace bath. A reverse operation withdraws the charging box from the furnace and disengages the head from the "insert," so that the next filled box can be handled.

The rocking hoist ram, in conjunction with the traverse and long travel motions of the charger, is also used for marshalling the trains of bogies of charging boxes up to and away from the fronts of the furnaces. The chariot collects and distributes the main current to its three motors by means of T section steel conductors on the machine parallel with the line of movement of the chariot. All the charger motors are controlled from the driver's cab, and the charging machine control cable consists of a multi-core heavily protected t.r.s. trailing cable which provides the necessary flexible connection between the relative fixed and moving points of the main charger body and the chariot. Except for long travel and traverse, all the motors are equipped with Igranic series brakes.

An indication of the extremely heavy work imposed on these chargers is the very high ratio of the charger maintenance man-hours to the overall melting shop operation man-hours. The main supply

Each of the molten pig iron mixers is equipped with two 75 h.p. motors for tilting the mixer





The electric locomotive is propelled by two 75 h.p. series motors

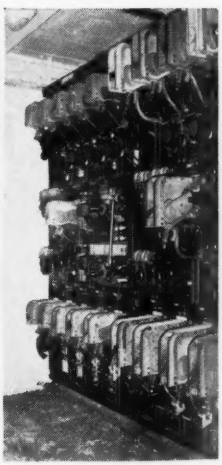
rails and collector gear for the chargers are similar to those for the cranes generally and the electric locomotive. All the charger motors are G.E.C. machines and are all controlled by Igranic contactor gear.

Each of the molten pig iron mixers is equipped with two 75 h.p., 440 V, G.E.C., d.c. compound mill type motors for tilting the mixer. These are mounted on the concrete pedest[illegible] of the mixers an[illegible] are supplied direct[illegible] from the Abbey d.c. [illegible]tri-bution system (see *Electrical Review*, [illegible]nd November, [illegible]1). Normally one [illegible]otor of each pair runs [illegible]dle as a stand-by. [illegible]he normal power tr[illegible]ns-mission is by w[illegible]rm from the com[illegible]on shaft, then throu[illegible]h a double pinion [illegible]nd finally on to a [illegible]ack on the periphery of the mixer shell.

Each tilting motor is equipped with an Igranic shunt brake which is de-energized at the first step of the five-step drum type reversing controller. These motors are controlled from a "pulpit" about 20ft directly above the mixer motors. The pulpit contains four small crane type Igranic controllers, each with a "dead man" handle, for the four mixer motors.

The other three motors are one 3 h.p., a.c. machine for the f.d. fan and two similar motors for the counterbalance

Left: **Separate and facing boards are provided for the a.c. and d.c. contactors for the mixer plant motors.**
Right: **Compartments in the turret of each 300 ton crane serve as convenient chambers for the electrical control equipment**



cove over the receiving and pouring spou which are situated diagonally on the and side of the mixer, respectively. Inte icked Allen West contactor gear is con ed in a brick chamber in the basemen at the 21ft level, and the various con ors are operated by the controls in the pit.

S rate and facing boards are provided for a.c. and d.c. contactors. In both cas the operating coils are d.c. and are sup d from local rectifiers.

T Greenwood & Batley electric locomo which hauls the hot metal transfer car from the mixers is driven by two 75 h. series motors, each of which transmit through gearing to one of the axles. The motors are resistance controlled by means of contactors mounted on an Igranic steel panel in the cab. The locomotive can also be remotely driven from either of the transfer cars through a 16 core control cable contained in armoured asbestos hose. There is a stand-by hand brake on the locomotive, but normal control is by plugging and dynamic braking of the motor.

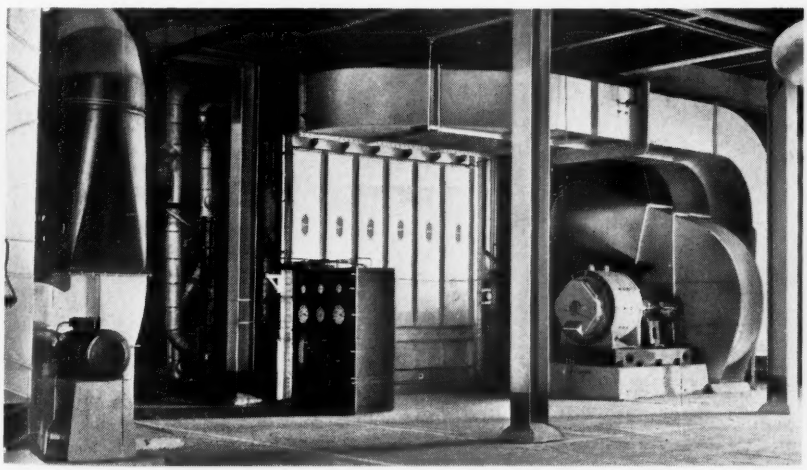
Apart from the cranes, of course, there are comparatively few large electric drives associated with the actual open hearth furnace installations. The largest in each case is the Laurence, Scott & Electromotors 150 h.p., d.c. motor which directly drives the i.d. " Sirocco " fan of the corresponding La Mont waste heat boiler. The motor and fan speed range is 420/650 r.p.m. Next in size are perhaps the 25 h.p., 975 r.p.m., s.c., Lancashire Dynamo & Crypto frame cooled motor driving the Aerex f.d. fan of each furnace, and the 22·5 h.p., G.E.C., s.c. motor driving the boiler water recirculating Harland Engineering pump.

The furnace doors, the dampers, the stopper rod oven and the valves are all motor operated with hand or automatic control. All the motors of each furnace are controlled from a desk incorporated in the furnace instrument and control centre.

There is a separate Allen West contactor board in the basement for each pair of furnaces, controlling the boiler pump, f.d. fan, damper and furnace valve motors. Further, each furnace has its own Allen West contactor panel mounted in a pulpit above the furnace control desk and serving the furnace door lifter and Askania fuel oil control pump motors.

We are indebted to the Steel Company of Wales, Ltd., for permission to visit the melting shop and to publish this article, and to the Electrical and Melting Shop Departments for their help in obtaining the information and photographs.

The waste heat boiler i.d. fan (150 h.p.) and furnace f.d. fan (25 h.p.) represent the largest open hearth furnace installation drives, excluding cranes



Testing Installation Wiring

Injection Current "Loopmeter" Procedure

IN order to decide whether a fuse will protect a circuit against an earth fault, as distinct from a short circuit, it is necessary to measure the resistance of the whole of the path which the leakage current must traverse in its return to the neutral point of the supply station, or distribution transformer.

The resistance so determined is termed the "loop" value and an instrument devised for this purpose has recently been referred to in a paper* read before the Utilization Section of the Institution of Electrical Engineers. It is designed for testing a.c. 50 c/s circuits at 200/250 V by the current injection method. A very convenient feature is the provision of a normal three-pin plug connector that enables the instrument (Fig. 1) to be energized from any socket selected as an outlet from the circuit to be tested. No other attachments are needed since the same plug also connects the ammeter and voltmeter (both moving iron type) incorporated in the instrument to the neutral

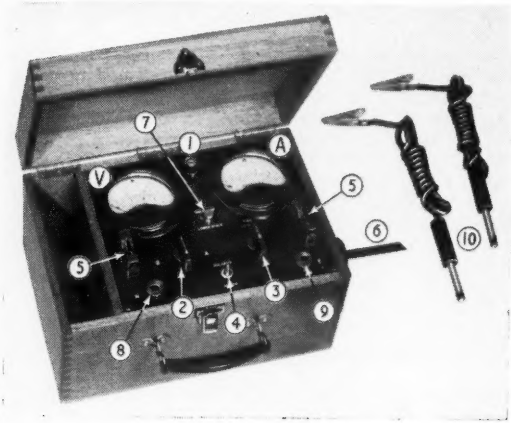


Fig. 1.—"Loopmeter" circuit tester with (right) jack-plug connectors V voltmeter, A ammeter, 1 neon lamp, 2 two-pole main change-over switch, 3 polarity reversing switch, 4 test switch, 5 rewirable supply fuses, 6 three-core mains connector plug, 7 voltmeter push-switch, 8 neutral socket, 9 earth socket, 10 jack-plugs

* "Domestic Electrical Installations: Some Safety Aspects," by H. W. Swann, Senior Electrical Inspector, Factory Dept., Ministry of Labour and National Service. (See *Electrical Review*, 25th January, 1952, pp. 155 and 177.)

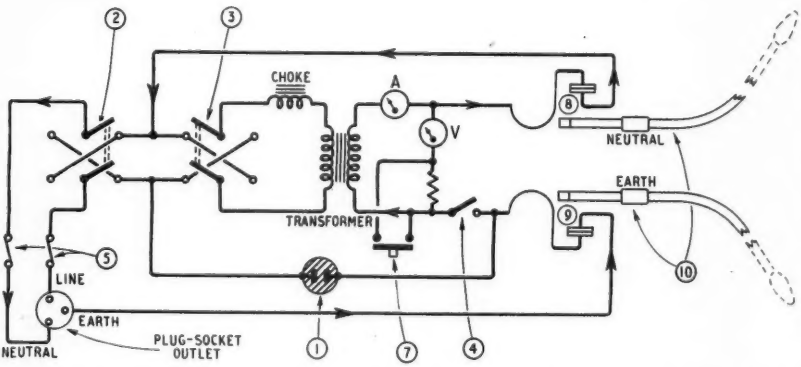


Fig. 2.—Schematic circuit diagram of instrument, with arrows showing direction of injected test current

and earthed conductors of the circuit being tested; this enables the injected current (up to 8 A) to traverse the loop formed (Fig. 3) by the earth-return path to supply-neutral earthing point and the neutral conductor back to the test-plug socket.

The methods of using the device are as follows:—

(1) To test a 5 A three-pin BS socket: insert the three-core connector plug and move main switch 2 to its alternative positions; glow of the neon indicator lamp 1 proves that the socket outlet under test is wired to correct polarity whereas if the lamp does not glow in either position of switch 2 it means either that the lamp is not functioning or that there is no "earth supply" to the instrument. The latter can be checked by inserting a jack-plug 10 into the earth socket 9 of the instrument and applying it to some known earth.

Having thus "set" the instrument with the switch 2 in the position that makes the lamp 1 glow, circuit testing may proceed by actuating test switch 3 and noting the ammeter (0–10 A) and voltmeter readings. If the latter indicates less than 10 V on its 0–50 V scale, a more accurate reading can be made by pressing the push-switch 7 to bring a 0–10 V scale into use. The impedance in ohms of the circuit being tested is found by dividing the voltage by the injected amperage (volts/amps = ohms) indicated by the instrument meters.

This procedure should be repeated with the polarity reversing switch 3 changed over for obtaining a mean observation to minimize error; any difference between two sets of readings would be due to small voltages above earth potential. The test switch 4 must not in any circumstances be operated unless the neon lamp 1 is glowing. Disregard of this precaution will permit the full line voltage to pass to earth through the instrument, thus destroying its meters, or, alternatively, raising protective metalwork (if unearthed) to 250 V above earth potential.

(2) Socket outlets rated at 15 A can be tested in a similar way with the aid of a 15 A to 5 A adaptor.

(3) By employing terminal leads and driving additional earthing rods (Fig. 3) it is possible to determine whether any unduly high resistance which the instrument may detect is situated on the consumer's premises or at the connection to earth of the neutral in the supply substation.

(4) This type of instrument indicates the total resistance of the circuit loop being tested and consequently permits calculation of the maximum earth-leakage current that can flow upon breakdown of the circuit insulation. One is thus enabled to relate

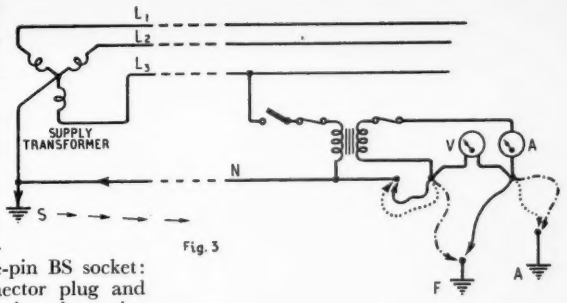


Fig. 3

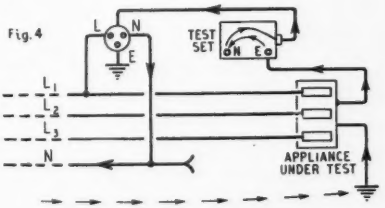


Fig. 4

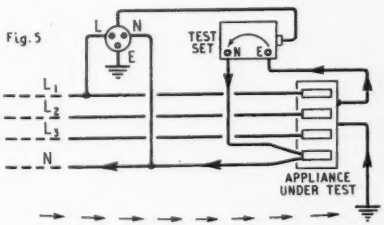


Fig. 5

Fig. 3.—Three-electrode loop test method

—— leads for No. 1 test giving S + F
..... leads for No. 2 test giving S + A
– · – · – leads for No. 3 test giving F + A
F = ½ (loop S + F + loop F + A − loop S + A)
S = ½ (loop S + A + loop S + F − loop F + A)

Fig. 4.—Test circuit for appliance without its own neutral; injected current follows arrows

Fig. 5.—Test circuits for appliance incorporating neutral; injected current follows arrows

the fault current to the settings of the main, sub-main and sub-circuit fuses.

(5) For testing the earth continuity of fuse boxes, switch cases, motors, etc.: proceed as before in test (1), plugging one of the jack-plug test leads into the E.9 socket of the instrument and connecting its end clip to the frame of the apparatus under test. Note that the neon lamp will not glow unless the earthing connection is made. It will be observed (Fig. 4) that the injected testing current flows through the neutral of the instrument supply and so may have quite a "long run" if the instrument is energized from a lighting circuit socket. Therefore, if the appliance being tested has a neutral of its own, or if a more direct neutral is available, it may be connected to the instrument by inserting the second jack-plug test lead into the N.8 socket (Fig. 5).

(6) For checking the continuity of the earthing leads of portable tools, etc., or of an appreciable length of conduit: insert the two jack-plug leads into the N.8 and E.9 sockets respectively of the instrument and then apply them to the length of conduit, etc., to be tested. If leads of greater length are needed for testing a long run of conduit, it is advisable to determine their resistance separately and subtract it from the total resistance measured in the test. It is unnecessary in this case to obtain a mean reading with the aid of the polarity change-over switch 3 and it will be observed from the basic circuit diagram (Fig. 2) that insertion of the jack-plugs automatically disconnects the low-voltage side of the instrument from its higher voltage input side.

This "Loopmeter" is manufactured under licence from the Ministry of Supply by John Drummond (Engineers), Ltd., 23, Lochburn Road, Maryhill, Glasgow, N.W. It weighs 20 lb and the dimensions are 13 by 9 by 8in deep.

European Coal Prospects

FROM the Organization for European Economic Co-operation we have received a report on "Coal and European Economic Expansion." This surveys the possible course of coal production and consumption during the next few years. At the outset it is stated that in 1951 there was a difference of 35 million tons between the coal available to the O.E.E.C. countries from their own resources and the quantity needed to meet current consumption and stocking. It is estimated that in 1956 there will still be a gap of between 25 and 35 million tons; in 1952 a deficiency of 38 million tons is expected.

By 1956, it is estimated, 60–70 million tons more than in 1951 will be needed. Power stations will account for 15–21 million tons more and carbonization (including gasworks) for 29 million tons.

The Organization's experts feel that the effects of the improved coal utilization in power stations will be an important factor in the future. The proportion of relatively inefficient plants is still high and as new ones come into operation many of the more obsolete stations will be closed down. The report says that in Western Germany coal consumption per kWh decreased from 4,600 calories in 1949 to 4,000 calories in 1951 and is expected to decline still further. France has shown an improvement of from 7,000 calories in 1946 to 4,500 at present and the expected figure for 1956 is 3,500 calories. It is mentioned that improvement has also occurred in the United Kingdom and other countries.

A further consideration to be borne in mind is the increasing use of low-grade fuels for electricity generation. In Germany the use of brown and low-grade hard coal will be considerably expanded and in France big developments are planned in colliery power stations which will depend almost exclusively on low-grade fuels. Furthermore, even in the use of these fuels a marked increase in efficiency is forecast.

It appears that an annual increase in industrial production of 6 per cent can be met so far as thermal power generation is concerned by an increase of 5·5 per cent in the consumption of hard coal, equivalent to an extra 15 million tons as compared with 1951.

On the other hand the Electricity Group estimates that the increase in all types of fuel for power stations between 1951 and 1956 will be of the order of 30 million tons assuming average "hydraulicity" [a term which evidently means hydro-electric development and operation]. Of this the increase in consumption of hard coal would be 21 million tons.

So far as industry is concerned improved efficiency of use of coal is expected as well as a continued substitution of electricity for raw coal. By 1956 (as compared with 1951) an annual increase in consumption of 9–13 million tons is anticipated. Domestic consumption is estimated to rise by 7 million tons by 1956.

Cable Short Circuit Currents

Some Notes on the Factors Limiting Permissible Ratings

By E. A. BEAVIS, M.I.E.E.

THE question of uprating the permissible short circuit currents for cables has been given much consideration, but the answer still awaits the results of experimental investigations that are being undertaken by the Electrical Research Association. From evidence so far available it would seem that the conductor temperature can be raised appreciably above the present level without causing deterioration of the dielectric, although the current carrying capacity of the lead sheath-to-earth faults[1] may then become a limiting factor.

In an article[2] putting forward the views of the Cable Makers' Association attention is drawn to certain inherent features of a cable installation which incline the C.M.A. to deprecate the tendency to increase conductor temperature. It is stated that not only is there a possibility of weakening the joints by softening the solder, but the increased magnetic forces resulting from heavier short circuit currents could easily impair the internal structure of the cable. These particular aspects of the short circuit conditions can, with interest, be examined in greater detail in order to estimate to what extent they limit cable ratings.

Although, in general, enclosing sockets or ferrules are used for making soldered conductor joints there is no specified standard practice; in many cases flush type ferrules and even plain soldered strands have been employed. Large ferrules will increase the thermal capacity of the joint appreciably and so reduce the ultimate temperature rise, as indicated by the examples given in Table I.

Standard ratings must, however, be generally applicable to all types of cable installation and it is essential therefore that the limiting temperature should not be greater than that required to safeguard the plain soldered conductor.

Tinman's solder actually melts at about 185 deg C but tends to soften somewhat below this temperature and, although it is not anticipated that joints under normal conditions would loosen or pull away at temperatures below the softening point, the tensile strength (Table II) is undoubtedly much reduced with increasing temperature.

Table II.—Strength/Temperature relation for Solder

Temperature deg C	0	100	140	160	180
Relative strength of solder	1·0	0·9	0·6	0·4	0

The mechanical strains resulting from sudden expansion and contraction due to temperature changes or from the magnetic forces created will vary with the type of cable and method of installing, depending

[1] *Electrical Review*, 12th August, 1949.
[2] *Electrical Review*, 10th November, 1950.

Table I.—Effect of increased thermal capacity of joint

Conductor Area, sq in	Conductor Joint		Short Circuit data for one second period			
			Temp. deg C		Current for 120 deg C at Joint	
	Type	Area (sq in)	Rise	Maximum	Ratio	Max. (amps)
0·0225	Conductor only ..	0·0225	50	120	1·0	1,290
	Enclosing ferrule:					
	$\frac{1}{16}$in thick	0·05	14·6	84·6	1·79	2,320
	Plain soldered strands	0·0064	43·4	113·4	1·065	1,375
0·20	Conductor only ..	0·20	50	120	1·0	11,430
	Enclosing ferrule:					
	$\frac{1}{16}$in thick	0·127	29·4	99·4	1·28	14,650
	$\frac{1}{8}$in thick	0·279	19·8	89·8	1·55	17,700
	Plain soldered strands	0·064	42·9	112·9	1·072	12,250

upon whether movement is relatively free or severely restricted. There is naturally an element of time-lag in the heating effects, but when registering for time-to-break periods extending to seconds it is considered inadvisable to allow the maximum joint temperature to approach too near the critical value.

The extra thermal capacity of the solder provides a slight alleviation of temperature in the plain soldered joint—over 10 deg C on approaching the softening range—but the time element of fusion is small. Assuming the melting point of solder to be critical at 180 deg C and that this temperature is reached during short circuit, which will occur if the conductor maximum is raised to 200 deg C, then an additional 20 per cent over the given time-to-break period will melt the solder completely.

A further danger exists subsequently in that the cooling down period is slow by comparison with the rapid heating up of the conductors, which thereby remain at an elevated temperature (80 to 90 per cent of the maximum) for a second or so after the short circuit current is broken.

In practice the melting point of solder is far from critical and, as mentioned previously, its tensile strength is much reduced on softening. From the safe temperature aspect, therefore, the short circuit current for the plain soldered joint and also possibly the flush ferrule type should be so limited that the conductor maximum does not much exceed 160 deg C. With enclosing ferrule types the temperature limit affecting the solder itself remains the same, but the maximum permissible short circuit current will depend entirely upon the increased thermal capacity of the joint relative to that of the conductor.

The practical evidence available respecting damage to cables from magnetic forces is very meagre and so, without carrying out a number of experimental tests on different types of cable, it is difficult to determine from this aspect what the safe current should be for a given size of conductor.

As magnetic force increases with the proximity of the conductors, more serious effects can occur with multi-core cables (wherein the separation is small and there is only the inherent strength of the internal structure to resist deformation) than with single-core cables where external bracing can afford additional strength when required. During the period of short circuit the force alternates between a maximum, corresponding with the peak current, and zero; but it is the instantaneous initial rise of the current which presents the

Table III.—Tensile Strength of Cable Belts

Breaking stress of belt papers, T = 256 lb/ft run (5 mil paper).
Breaking stress of c.w. tape, T = 960 lb/ft run.

Magnetic force, $F = \frac{9{\cdot}34.\ I^2.\ 10^{-7}}{S}$ lb/ft run.

Rupturing current, $I = \sqrt{\frac{\sqrt{3}\ T.S.\ 10^7}{9{\cdot}34}}$ amperes.

Type of 3-core Cable		Number of Belt Papers	Belt Tensile Strength lb/ft run		Axial Spacing (S) in	Short Circuit Currents	
Voltage	Conductor Area, sq in (shaped)		T	$\sqrt{3}T$		Rupturing Amperes	Safe
L.V. ..	0·1	4	1024	1775	0·396	27400	19400
	0·25	4	1024	1775	0·592	33500	23700
	0·5	6	1536	2660	0·816	48200	34100
6·6 kV ..	0·1	10	2560	4430	0·476	47500	33600
	0·25	10	2560	4430	0·662	56000	39600
	0·5	12	3072	5320	0·896	71500	50500
11 kV ..	0·1	10	2560	4430	0·536	50400	35700
	0·25	10	2560	4430	0·722	58500	41400
	0·5	12	3072	5320	0·956	73700	52100
22 kV ..	0·1	22	5632	9750	0·666	83300	58900
	0·25	22	5632	9750	0·852	94000	66500
22 kV (screened)	0·1	C.W. Tape	960	1660	0·852	39000	27600
	0·25		960	1660	1·054	43300	30600
	0·5		960	1660	1·314	48100	34200
33 kV (screened)	0·1	C.W. Tape	960	1660	1·038	43000	30400
	0·25		960	1660	1·169	45600	32300
	0·5		960	1660	1·436	50600	35700

more dangerous feature. Under the worst conditions the latter can be entirely asymmetrical, reaching about 1·75 times normal peak and so trebling the maximum value of magnetic force.

The disruptive repulsive force acting on the conductors of the normal type of three-core cable will tend to open out the laid-up cores, since these are the most rigid part of the dielectric, thrusting them against the outer belt insulation. The pressure exerted will be also resisted by the rigidity of the lead sheath, but if any outward movement of the cores takes place the wormings, or fillers, which are relatively soft, will be squeezed in and the contour of the cable will be deformed. Furthermore, the strain will tend to stretch the belt papers and when these break it means that rupture of the cable internal structure will have taken place.

There is freer movement of the belt with circular conductors: the more compact form of the internal structure with shaped conductors tends to exert tensile stress on the belt papers straightaway, as little displacement of the core is possible.

An approximate estimate of the strength of the belt papers and of the rigidity of the cable sheath can be ascertained from mechanical tests, but the actual conditions obtaining in practice cannot be properly simulated by this means. Results deduced from these empirical values must therefore be of a somewhat tentative nature, but will serve to indicate the order of the effects to be considered.

The tensile strength of impregnated paper tapes varies not only with the type of paper but may also be affected by moisture content, which is a factor practically non-existent in the cable dielectric itself. Samples of actual belt insulation as taken direct from various cables have been made use of to obtain a reasonably mean value for the strength of cable paper. In several cases the breaking stress was rapidly applied, giving much higher comparative figures for belt strength. From these data some calculations have been made for the tensile strength of belts on three-core standard cables and the short circuit currents necessary to produce rupture, see Table III. The limiting three-phase symmetrical magnetic force is assumed to be equal to $\sqrt{3}$ times the belt tensile strength.

With respect to non-belted cables, such as the three-core screened types, the laid-up cores are tightly wrapped with a layer of

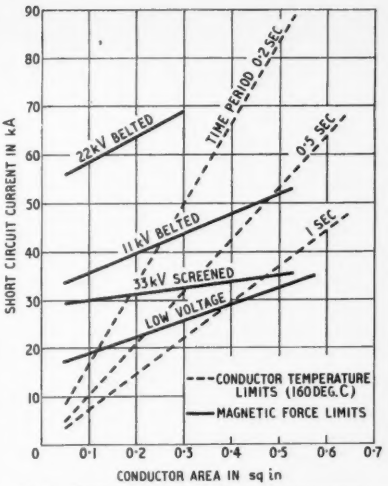


Fig. 1.—Proposed limitation of cable short circuit currents

overlapping copper-woven fabric tape and so the inherent strength will be somewhat reduced. However, the magnetic force for a given current will be relatively smaller on account of the increased axial spacing between conductors in these higher voltage cables.

The part played by the lead sheath in reinforcing the internal strength of the cable is not easy to assess as so much depends upon its relative tightness when acting as a restraining factor. The rigidity of the lead will first resist distortion before strain comes on the belt and then tend to oppose the stretching with the increasing magnetic force. The sheath can in this way add appreciably to the disruptive strength of the cable, but in practice its effectiveness is indeterminate owing to variability in the closeness of contact with the belt. It may be wise therefore to neglect these possibilities altogether in estimating the safe limits for short circuit.

What are safe limits in service? Short circuits should not be permitted to become severe enough to create unnecessary distortion and so promote possible deterioration that may reduce the cable life. The elongation attained by cable papers at breaking strain is small; with rapidly applied stress it is only of the order of about 1 per cent. Reversible stretch occurs up to loads slightly less than half tensile strength.

A reasonable factor of safety will therefore be attained by limiting the magnetic force to about 50 per cent of the rupturing strength.

The maximum short circuit current necessary to achieve this limit will be $\frac{1}{\sqrt{2}}$ times the rupturing current and is indicated in Table III. As already pointed out these values will be somewhat conservative as the cable strength must be appreciably greater for the extremely short time period of the applied stress occurring in actual service; also any resistance offered by the lead sheath has been ignored. Curves have been plotted (Fig. 1) to show the proposed limitations of the short circuit current due both to the magnetic force and to the temperature rise as well as their effect on the time-to-break period. It will be noted that magnetic force restricts the short circuit rating for the shorter time periods, particularly with respect to conductor sizes of 0·25 sq in and greater.

Australian Electrical Industry

Continued Expansion

THE manufacture of electrical goods in Australia continues to expand. The total output of factories so engaged was valued in 1949–50 at £A42,756,000, an advance of 25 per cent on the previous year. This advance followed one of nearly the same percentage between the two preceding years. The principal lines of manufacture are given in the accompanying table, with notes of increases or decreases (which are few) compared with 1948–49. The group totals may include goods made at works not wholly engaged in electrical manufacture.

Factories manufacturing electrical machinery and equipment numbered 811 (390 in N.S.W., 238 in Victoria, 46 in Queensland, 57 in South Australia, 63 in Western Australia, and 17 in Tasmania), with employees totalling 30,956. The year's wages aggregated £13,563,000. Cost of power, fuel, light, etc., was £453,000 and of raw materials used £21,149,000. While the total value of output was £42,756,000, production (output minus cost of raw materials, containers, power, fuel, etc., and representing the value added in course of manufacture) totalled £21,154,000. Value of land and buildings was £6,293,018, with plant and machinery worth £4,127,152. The average wage was £445; average value of output per person £1,381; and average value of production £683.

At the end of June, 1950, persons employed in the electricity supply industry in Australia numbered 9,595, with wages and salaries for the year totalling £5,466,000. The value of output was £30,512,000; average salary or wage per person £575; and value of output per person £3,180. Electricity sold or used outside generating stations totalled 8,054·8 million kWh; used in generating stations 443·1 million kWh; and lost 939·7 million kWh. Land and buildings were valued at £13,485,848, with plant and machinery at £45,453,536.

Class of Goods Manufactured	1949–50 £A (000)	Inc. or dec. on 1948–49 £A (000)
Alternators	75	+ 18
Generators	518	+ 230
Motors (for sale):—		
Under 1 h.p.	970	+ 37
1 h.p. and under 2½ h.p.	385	+ 17
2½ to 5 h.p.	321	— 17
5 h.p. to 10 h.p.	289	+ 57
10 h.p. to 50 h.p.	284	+ 9
50 h.p. and over	104	— 56
Transformers and convertors above 20 kVA	626	+ 4
Ditto below 20 kVA:—		
For use in neon signs	64	+ 7
" " " radio and toys	165	+ 10
" " " supplying power and light	305	+ 61
Storage batteries and accumulators:—		
For automobile and radio	1,993	+ 561
Power plant	354	+ 204
Other	253	*
Apparatus for telegraphy and telephony	3,169	+ 977
Electric meters	1,175	+ 476
Apparatus for regulating, starting and controlling	3,349	+ 927
Household fittings (switches, etc.)	1,636	+ 723
Portable tools and appliances	662	+ 310
Fans	317	— 52
Irons	255	— 29
Radiators and fires	205	— 35
Toasters	244	+ 57
Washing machines	1,339	+ 1,043
Vacuum cleaners (domestic)	859	+ 110
Cooking stoves	1,255	— 5
Stovettes	537	— 13
Refrigerators, household:—		
Absorption type	585	— 432
Compression	6,258	+ 1,440
Refrigerators, commercial	1,173	+ 471
Wireless apparatus	11,762	+ 1,850

* Comparative figures not available.

VIEWS on the NEWS

By REFLECTOR

BODIES which are established largely for the protection of the public against any encroachment of "officialdom" upon their rights and freedom should never conduct their affairs in secret. This consideration certainly applies to Electricity Consultative Councils. So far as I am aware, these Councils, generally, recognize their obligations and admit the Press to their meetings. An exception to the rule was the South West Scotland Electricity Consultative Council whose exclusion of the Press recently raised something of a storm in the area. Now, I am pleased to note, the chairman, Mr. A. B. Mackay, has announced the Council's willingness to open its meetings to reporters.

* * *

Rewards or penalties? Which are more likely to secure the desired results? In an article upon American meter practice in the February *Electrical Power Engineer* Mr. H. S. Petch, B.Sc., M.I.E.E., says that in the United States the electricity tariff is based on an assumed low power factor and a stepped rebate is given for better *average* power factor. In this way the desired economic pressure to improve load factor is obtained at low cost. This method certainly seems more attractive than imposing extra charges when p.f. falls below a specified high level.

* * *

I seem to recollect that during the inter-war years somebody in this country devised a method of projecting illuminated advertisements on to a clouded sky. The authorities adopted an unfavourable attitude but whether that was why the experiments were dropped or whether the reason was technical difficulties I do not know. It couldn't have been a lack of cloud. Now *Picture Post* has reported, as though it were something entirely new, that a German has started using "cloud hoardings" for advertisements, having produced a five million c.p. projector for the purpose. I consider this a doubtful improvement to the night sky, but I may be old-fashioned.

* * *

After the electrical lie-detector comes the electrical mating machine: maybe a development of the earlier device. Naturally the invention is an American one. The *Daily Mirror* describes it as a method of determining the suitability of couples for one another. "With metal bands attached to their wrists they hold hands, then kiss, while the robot measures the charge of electrical energy in their bodies." It is explained by the inventor that "there is a definite electric relationship between compatible and incompatible subjects, particularly between male and female individuals." A matter of impedance, I suppose.

* * *

It is some years since I was in Thetford and I do not remember seeing many (if any) swans there. Yet almost every day I read a news item reporting that a swan has been electrocuted in Thetford or has been successful in breaking an electric line in the town without apparent harm to itself. I have visions of the townspeople ankle deep in swansdown and dining regularly on that regal fowl.

* * *

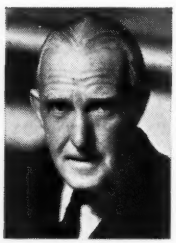
It is reported by the *Yorkshire Post* that the commercial manager of the Yorkshire Electricity Board has suggested a "power saving" game for children. A dice (or die) is thrown. If the result is a "one" no electricity is used in the home for the first ten minutes of each hour; if a "two" comes up the cut is made in the second ten minutes, and so on. One consequence of the suggestion has been a protest against fostering the gambling instinct in children. I consider that the protest is as absurd as the game which has prompted it.

PERSONAL and SOCIAL

News of Men and Women of the Industry

THE Council of the Institute of Welding has conferred the Sir William J. Larke Medal, the highest award of the Institute, upon **Mr. W. S. Atkins,** B.Sc., M.I.C.E., M.Inst.W., for his paper " Continuous Welded Structures—Abbey Works, Port Talbot."

Sir John Kennedy, O.B.E., M.I.C.E., M.I.E.E., informs us that he will shortly be severing all connection with the Uganda Electricity Board. Any future communications should be sent to him at Woodstock, Chinthurst Lane, Shalford, near Guildford, Surrey. Sir John was appointed a member of the Board by the Governor of Uganda in 1948, upon his retirement from the position of chairman of the Electricity Commission, and attended to the Board's interests in London. In 1950 he became acting chairman during the absence of the chairman, Mr. C. R. Westlake, on long leave and spent some time in Uganda.



Sir John Kennedy

Dr. J. Hattingh is reported by *South Africa* to have been appointed chairman of the South African Electricity Supply Commission in succession to **Mr. A. M. Jacobs,** whose retirement was reported in our issue of 11th January. Dr. Hattingh was for some years on the staff of the American General Electric Co. Returning to South Africa he became lecturer in physics at Durban Technical College in 1923. Later in that year he was appointed technical assistant to the late Dr. H. J. van der Bijl in the Electricity Supply Commission, and subsequently he became a consulting engineer. Dr. Hattingh was appointed to the board of the South African Iron & Steel Corporation in 1949.

The Marconi International Marine Communication Co., Ltd., announces that, with effect from 1st January, **Mr. John Keir,** manager of the Service Division, has been appointed assistant general manager of the Marconi Marine companies, these comprising also the Radio Communication Co., Ltd., and the Marconi Sounding Device Co., Ltd. Mr. Keir joined the Marconi Marine Co. at the beginning of 1915 as a seagoing radio officer. He was later appointed instructor at Marconi House, London, and afterwards transferred to Glasgow as training representative for Scotland. After his return to London in 1919 he held various head office appointments until 1929, when he went to Brazil as managing director of the Companhia Nacional de Communicacoes Sem Fio, which he later reorganized as the Companhia Marconi Brasileira. Following this Mr. Keir returned to the United Kingdom and was appointed contracts representative for the Marconi Marine Co. in Scotland in 1946. Two years later he again went to Brazil on behalf of the Marconi companies, returning to Marconi House, Chelmsford, in 1949. In January, 1951, he became manager of the Service Division, and will retain responsibility for the work of this Division in his new capacity.

Mr. H. G. Towner, area manager for Venner, Ltd., is entering London Clinic on 25th February for an ear operation and expects to be away about a month. Mr. Towner has recently completed twenty-five years' service with the Venner organization.

Miss H. S. O'B. Hoare, who recently resigned from the position of publicity manager to Ferranti, Ltd., has now joined the Electrical Industries Benevolent Association. Miss Hoare will devote her energies to matters of general organization and will also act in the capacity of public relations officer. It may be mentioned that in 1940, on coming down from Oxford, Miss Hoare was responsible for organizing the first scheme to be launched in this country for raising money for all combined war charities along the lines of the Community Chest system of America.

Miss H. S. O'B. Hoare

Mr. John D. Blythe, who has been with Aidas Electric, Ltd., since the end of 1945 as technical representative for the area of the Southern and South Western Electricity Boards, is sailing with his family on the S.S. *Georgic* on 21st March to Canada.

He ... going to Toronto where he hopes to intro... e domestic electrical appliances of Brit... manufacture to the Canadian market. Mr. ...ythe joined the Jackson Electric Stove Co., ...td., in 1926 and represented it in the ...uth and South-West of England until 193... In August 1939 he joined the R.A.F. and ...ved until the end of 1945. He was dem...lized with the rank of flight lieutenant having been mentioned in despatches for ... services on the Continent.

Mr. **F. C. Lynam,** F.R.Ae.S., technical director of the Airscrew Co. and Jicwood, Ltd., of Weybridge, Surrey, has been appointed general manager of the company.

Mr. **J. Abberley** has resigned his position of works manager and director of the E.M.B. Co., Ltd., West Bromwich.

Mr. **E. Heyman,** sales manager of Smith's Electric Vehicles, Ltd., will be sailing to Canada on 27th February on the *Empress of France* for a business trip to Canada and the United States.

Mr. **D. F. Brown,** managing director, Westinghouse Brake & Signal Co., Ltd., was presented on 9th February with a mounted and inscribed "Brown" polarized relay by Mr. P. Croom-Johnson, on behalf of the London Transport Executive. The relay was devised by Mr. Brown's father, the late Mr. H. G. Brown (who afterwards became managing director of the Westinghouse Brake Co.), for the District Railway's d.c. electrification to prevent interference between traction current and track circuits. In the late 1920's these relays began to be replaced upon the adoption of a.c. track circuits; the last one came out of service in November last.

Mr. **J. A. Sumner,** M.I.E.E., M.I.Mech.E., manager of the Norfolk Sub-Area of the Eastern Electricity Board, was married recently to Miss Dorothy M. Gibson at Norwich.

The annual dinner of the **J. L. Eve Construction Co., Ltd.,** was held at St. Stephens Club on 8th February and was attended by nearly 100 members of the staff gathered from all parts of the country. Their guests included Mr. G. F. Kennedy, Mr. D. P. Sayers and Mr. H. W. Grimmitt. Mr. Kennedy acknowledged the toast of the guests and proposed the health of the company. Mr. J. L. Eve, in reply, mentioned some of the company's achievements and paid a tribute to the staff. He later presented a clock as sixtieth birthday present to Mr. J. Sharratt who has been with the company since its inception.

At the invitation of the chairman and directors, the staff of the Leyton works of the **London Electric Wire Co. and Smiths, Ltd.,** were entertained to dinner at the Tavistock Restaurant on 16th January. Mr. W. J. Terry, chairman and managing director, welcomed the guests and Mr. S. B. Klein, general manager of the Leyton works, proposed the toast of the company to which Mr. Terry replied. Among other head office executives present were Miss M. J. Waters and Mr. G. E. Jewell. After dinner there was a cabaret.

Dr. C. J. Smithells, M.C., director of research, British Aluminium Co., Ltd., has been elected president of the Institute of Metals for the year 1952-1953. He will take office on 25th March.

OBITUARY

Mr. John Lambert, who has died at the age of seventy-nine, was the first burgh electrical engineer at Perth. He joined the staff on the opening of the Electricity Department and retired in 1938.

Mr. G. N. Wright.—The death is reported of Mr. George Norris Wright, M.I.E.E., formerly chief electrical engineer to the London Power Co. Mr. Wright began his connection with the electricity supply industry early in the century as a pupil at the Nuneaton electricity works. In 1904 he joined the Newcastle Electric Supply Co. as a junior engineer and from there went to the Cleveland & Durham Electric Power Co., subsequently becoming transmission engineer and technical assistant. Mr. Wright, in 1924, was appointed electrical clerk of works during the construction of the first section of the Barking power station of the County of London Electric Supply Co. Two years later he transferred to the London Power Co. as distribution engineer. Later he became assistant chief electrical engineer and upon the death of Mr. H. A. Ratcliff in 1938 he succeeded as chief electrical engineer; he retired in 1949. While with the London Power Co. he was responsible for the design and construction of the company's original 22 kV network. Mr. Wright was chairman of the Tees-Side Sub-Centre of the I.E.E. in 1920 and had served on the E.R.A. Council.

The late Mr. G. N. Wright

Mr. William Innes, formerly of the North-Eastern Electric Supply Co., Ltd., has died at Whitley Bay at the age of seventy-seven. Mr. Innes joined the North-Eastern Co. at the age of twenty-eight and became resident engineer at the original Dunston power station. He held a similar post at Carville until 1919, when he was transferred

to the company's undertakings in the Cleveland district for two years. From 1936 until his retirement in 1938 he was chief generation engineer of the Nesco network.

Mr. William S. Graff-Baker, B.Sc. (Eng.), A.C.G.I., M.I.Mech.E., M.I.Loco.E., M.Inst.T., chief mechanical engineer (railways) of London Transport, died last Friday at the age of sixty-two. He entered the service of the Metropolitan District Railway in 1910 and was appointed chief mechanical engineer (railways) to the Board in 1935, being responsible for the design, construction, maintenance and overhaul of all London Transport's railway rolling stock, lifts and escalators. In the earlier years of the war Mr. Graff-Baker was seconded to the Ministry of Supply as Director of Tank Production. He was president of the Institution of Locomotive Engineers for the years 1944-45 and 1945-46 and was a member of the Council of the Institute of Transport from 1937 to 1940. He contributed many papers on electric traction to professional institutions.

The late Mr. W. S. Graff-Baker

Mr. H. D. Boden How.—The death occurred at Beckenham on 12th February of Mr. Horace David Boden How, who was a founder-director in 1912 of the Hallam Tire Electric Co., Ltd., wholesale distributors, Sheffield. He severed his connection with the company in 1937.

WILLS

Mr. H. W. C. Liddiard, of the Industrial Engineering Department of the British Thomson-Houston Co., Ltd., who died on 4th January, 1951, left £4,458 gross (£4,322 net).

Mr. A. P. Hayes, Derby and Burton Sub-Area engineer, East Midlands Electricity Board, who died on 28th June last, left £2,860 gross (£2,727 net).

Mr. E. J. Davies, M.I.E.E., formerly of Kennedy & Donkin, Ltd., who died on 14th October last, left £1,179 gross (£1,109 net).

Mr. J. Leadbeater, M.I.E.E., formerly borough electrical engineer to the Hampstead Borough Council, who died on 17th September last, left £10,958 gross (£10,900 net).

Sir Holberry Mensforth, K.C.B., C.B.E., M.Sc., M.Inst.C.E., M.I.Mech.E., former general manager of Metropolitan Vickers Electrical Co., Ltd., and associated with many other companies, who died on 5th September last, left £6,207 gross (£6,109 net).

NEW BOOKS

Fundamentals of Automatic Control. By G. H. Farrington. Pp. 285; figs. 169; index. Chapman & Hall, Ltd., 37, Essex Street, London, W.C.2. Price 30s.

The theories of servomechanisms and automatic control have always been closely related, but wartime necessity resulted in servomechanism theory gaining a considerable lead. The development of automatic process control theory has not been so rapid, partly because it is less amenable to theoretical study and partly because the required talent has not been forthcoming. In consequence, published literature is relatively sparse, which makes the publication of Mr. Farrington's book an event.

The book contains a wealth of information on the theoretical aspects of process control presented in an interesting and easily-digestible form. The twelve chapters are mainly concerned with control actions, control system equations, the characteristics and analysis of plants and the analysis of control mechanisms.

The treatment is mainly mathematical but can be easily assimilated. The author has advantageously borrowed mathematical techniques and solutions of physical problems and applied these to process control theory. This is evident from the use that is made of electrical analogues and the analysis of transmission lines and thermal diffusivity phenomena. Familiarity with related sciences is not taken for granted and full explanations are normally given. On one occasion, however, diversion into a related science is fuller than necessary. This occurs in Chapter 3, Section 6, which deals with the response of oscillating LRC circuits. Otherwise, the book is well balanced and does not over-treat minor aspects to the detriment of the more important ones.

To ...e electrical and communication engine..., the subject-matter is simplified and m...de interesting by the frequent use of electr...l analogues. For the non-electrical reade... these analogues, of course, may have the ...verse effect. Students, manufacture... and users of automatic process contr... who are anxious to appreciate the unde...ing principles will be grateful to Mr. ...rrington for filling a very obvious gap. R.S.M.

The Nature of Polyphase Induction Machines. By P. L. Alger. Pp. 397; ...gs.; index. Chapman & Hall, Ltd., ...7, Essex Street, London, W.C.2. Price 60s in the United Kingdom.

It is difficult to appreciate the exact connection between the title of this book and its contents but it may be read with ease and profit by university graduates in electrical engineering. It is an unusual compilation of pictures of motor frames, armature winding tables and outstanding design points of special interest to the author, rounded off with an insistence on the value of " equivalent " circuits and an outline of Kron's magnificent efforts to end the " jig saw puzzle " method of teaching electrical engineering.

The author's special interests appear in Chapters V, VI and VII:—the resistance and reactance calculations necessary for predicting machine performance; and in Chapter X:—vibration and noise and, as is natural to suppose, these chapters are good.

Chapter XII deals with Kron's equivalent circuits, and the derivation of these as given by the author appears to be the most logical physical synthesis that has appeared so far, since Kron himself published only the finished article and a bare outline of his reasoning. The reluctance and inductance transformations are simple mathematically but are most interesting as outlined in the book. This chapter also emphasizes the fact that Kron mainly deals with machines which are electrically and mathematically " ideal," e.g., without iron loss, field harmonics, saturation, stator and rotor slots, and all of these require especially careful consideration before being fitted into the " tensorial analysis," but it must be mentioned that Kron has now modified his generalized circuits to include field harmonics.

The author has shown clearly the effects of departures from the " ideal " and that for many cases associated with the performance aspect, these effects are only of secondary importance. The book is undoubtedly a useful addition to the literature on electrical machinery.—F.J.T.

Research Development

National Corporation's Second Report

THE second annual report and statement of accounts of the National Research Development Corporation (H.M. Stationery Office, price 9d net) shows that up to June, 1951, a growing portfolio of inventions (409 patents granted and 488 applications made) had been transferred to the Corporation from the Ministries of Supply and Works, the Admiralty, the D.S.I.R., the Board of Trade, the Medical and Agricultural Research Councils, the universities and other sources.

The Corporation is in process of acquiring the benefit of overseas rights in numbers of these inventions while certain organizations in Commonwealth countries have already made submissions of their inventions to the Corporation. The object is positively to exploit patents which may be acquired in the public interest and/or develop them to a stage which will permit manufacture under licence.

The report points out that the number of inventions transferred may be misleading if allowance is not made for the high rate of wastage entailed in abandonment of such patents as may not be deemed worth proceeding with. The report also explains the precise function of the Corporation in relation to the private inventor, which seems to be misunderstood.

During the year under review 78 inquiries for licences received from industry eventually proved to be abortive; 74 were in process of discussion or negotiation.

It is too early as yet to offer any forecast of what the Corporation's expenditure may rise to, but the £5 million (repayable to the Board of Trade) contemplated as expendable over the first five years will probably not, says the report, be reached unless some quite unforeseeable need arises.

Engineering Apprentices' Wages

LAST week, the Confederation of Shipbuilding and Engineering Unions presented a claim for an increase of £1 a week in the basic wages of engineering apprentices and other workers under the age of twenty-one to the Engineering and Allied Employers' National Federation.

The Convention Programme

Emphasis on Research

WE have now received the preliminary programme for the British Electrical Power Convention to be held at Bournemouth from 16th to 18th June. From the details given below it will be seen that the papers deal largely with research and load studies.

Proceedings begin at the Town Hall at 10 a.m. on Monday, 16th June, with a civic welcome by the Mayor of Bournemouth. Then follows the presidential address by Mr. P. V. Hunter, C.B.E., Hon.M.I.E.E.

At the afternoon session (2.30 p.m.) Sir Arthur P. M. Fleming, C.B.E., D.Eng., M.Sc.Tech., Hon.M.I.E.E., will present "A Survey of Research in the Electrical Industry." This will be supported by the following series of papers:—"Co-operative Research in the Electrical Industry" (on behalf of the Electrical Research Association), by Dr. S. Whitehead, M.A., M.I.E.E.; "Research in the Electricity Supply Industry" (on behalf of the British Electricity Authority), by Dr. J. S. Forrest, M.A., M.I.E.E.; "The Nature of Research in the Manufacturing Industry" (on behalf of the British Electrical and Allied Manufacturers' Association), by Dr. K. J. R. Wilkinson, M.I.E.E.; "Researches into some Problems Associated with Steam Generation" (on behalf of the Water-Tube Boilermakers' Association), by Mr. W. F. Simonson, B.Sc., A.C.G.I., M.I.Mech.E.; paper on behalf of the Cable Makers' Association (author and title to be announced); and "The Influence of Research on the Electric Lamp Industry" (on behalf of the Electric Lamp Manufacturers' Association), by Dr. J. N. Aldington, B.Sc., F.Inst.P., A.M.I.E.E.

During the afternoon (4 p.m.) the ladies are asked to meet Mrs. P. V. Hunter at tea in the Pavilion Ballroom and in the evening, again in the Ballroom, the Mayor and Mayoress of Bournemouth will hold a reception (8–8.30 p.m.).

On the Tuesday morning (10 a.m.) at the Pavilion Concert Hall the session will be devoted to a lecture and demonstration on "High Performance Dielectrics with special reference to Power Factor Improvement" by Dr. R. S. Vincent, M.I.E.E., F.Inst.P.

The customary Convention luncheon organized by the Electrical Association for Women will take place at the Pavilion Ballroom at 12.30 p.m.

The subject for the afternoon session held at the Pavilion Concert Hall will be "The Merits of the Electric Water Heating, Electric Cooking and Heating Loads on an Integrated Supply System." Four papers (the titles of which have not yet been decided) will be presented by Mr. R. Y. Sanders, F.S.S., on behalf of the British Electricity Authority; Mr. C. Hubert Smith, M.I.E.E., on behalf of the Electric Water Heater Manufacturers' Association; and Mr. J. A. Fraser and Mr. Raymond Berry, on behalf of the B.E.A.M.A.

The annual dinner and dance is to take place at the Pavilion Ballroom in the evening, commencing at 7 p.m.; accommodation will be available for 650.

An "Electrical Forum" is arranged for the Wednesday morning session (10 a.m.) at the Pavilion Concert Hall. A panel will be selected by the Council to answer questions which have been submitted before the meeting. Detailed information will be given in the programme. The proceedings are to conclude with the annual general meeting, timed for 11.30 a.m.

Cable Ship Launched

THE 2,550 ton cable ship *Stanley Angwin*, a sister ship of the *Edward Wilshaw* built for Cable & Wireless, Ltd., four years ago, has been launched by Swan Hunter and Wigham Richardson, Ltd. When the ship is commissioned in May she will be the most modern cable repair ship afloat, capable of working in any depth of water and in any climate in which cables are laid. The vessel will have an operating range of 10,000 miles, and a coiling capacity for about 400 miles of deep-sea cable. She will operate from Colombo eastwards to the Pacific Ocean in which there are 20,000 miles of cable.

CORRESPONDENCE

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents.

Bedroom Heating

WHILE agreeing with Mr. A. C. Johnson about the risks involved in the heating of bedrooms, the use of any form of convection heater seems to be fundamentally wrong. Apart from the medical objections associated with sleeping in heated bedrooms, it would appear to be unnecessarily expensive to maintain these rooms under thermostatic control for such short periods of use, namely, in dressing and undressing. A further point which is against both convective and continuous heating is that the ventilation rate required for bedrooms is slightly higher than for living rooms, and if 1½ to 2 air changes an hour are introduced there will be much heat lost by ventilation.

With these points in mind it is felt that the correct method of supplying heat to the bedroom is by a radiant electric safety fire complying with the new B.S.1670 of 1951. Such a fire would be available for use when and where needed and for the required period of time. Fires of this type are now available in portable form and if used only for the short periods mentioned the radiant heat would establish comfortable conditions economically without any of the objections referred to above. The pre-heating period is almost negligible with these fires and, as the majority of consumers would require them before 8 a.m. and after 9 p.m., the question of their use during peak periods does not arise.

Manchester, 8. C. W. BATES.

I DO not quite follow Mr. Duncan W. Low's point in his letter in your issue of 8th February that the water filled electric radiator is a better proposition than the oil filled radiator.

The disadvantage of the water filled radiator is that it requires provision for expansion and some safety device as well as some method of refilling. There is also the danger of frost in very cold weather when the appliance is left in an unheated room.

Furthermore, if the radiator is not kept filled regularly to the upper manifold, free circulation of the water will be impaired and boiling likely to take place, which, if not noticed, will cause the water to boil away completely, with subsequent burning out of the element.

Oil, I understand, is used primarily because it is safer. If it were necessary to provide greater storage capacity this, of course, could be achieved by increasing the size of the radiator.

Southampton. A. C. JOHNSON.

Portable Appliance Leads

THERE must be hundreds of miles of tough rubber and other flexible cables wasted each year owing to the fact that portable electric tools and domestic apparatus are often supplied with a short length of cable attached. My experience is that the cable has to be replaced by a longer one and the short length is scrapped. Can the trade do nothing to prevent this waste which the purchaser has to pay for?

ARTHUR F. CARTER,
M.I.E.E., M.I.P.E.

French Area De-nationalized

ELECTRICITÉ de France has lost control of 247 communes which will now be served by the Vienne Electricity Syndicate. This curious state of affairs goes back to 1949 when the Syndicate ceded the network of the 247 communes to E.D.F. for a period of 15 years. The network was not included in the original law for several reasons, one being that the suppliers were not a private company. The agreement between E.D.F. and the Syndicate met with some opposition, however, and after some controversy it was decided to refer the whole question to the Conseil d'État (equivalent to the Privy Council). This body ruled that under the nationalization law a network could not be the property of two bodies, nor could one body lease a network. It ordered that the network should either become the property of E.D.F. or be handed back to the Syndicate. The matter was put to the vote of the communes and E.D.F. lost the communes by 280 votes to 150.

Cape Town Power Plans

Difficulties Confronting Corporation

From a Correspondent

THE Cape Town electricity undertaking is on the eve of large expansion and reorganization, concerning which the advice of the City Council's consulting engineers in London is being sought. To-day the two municipally-owned generating stations—Table Bay and Dock Road—pool their output with that of the Salt River station of the Electricity Supply Commission. In 1957 this pooling agreement will cease and the city will have to consider generating its own power, or purchase from " Escom " what it cannot itself produce.

Three large areas on the Cape Flats, one of which is known as Duinefontein, are being considered by the municipality as possible sites for a new power station, to be ready by 1959 at the latest. The intention is to use the effluent from the Athlone sewage disposal works as the water intake to the condensers of this power station.

Dock Road Demolition

Meanwhile the most pressing problem concerns the demolition of the old Dock Road power station, which, in terms of an agreement with the Foreshore Board, is already overdue. The full development of the " shopping precinct " on the foreshore, as well as the building of Monument Avenue, cannot be undertaken until the old power station has gone and the site boundaries of the Table Bay power station have been revised to conform to the foreshore scheme. Demolition cannot take place until Escom's new station, now being built at Salt River, is producing at least that quantity of electricity which will be lost by the demolition of the old station in Dock Road.

Piles are being driven for the foundations of this Salt River No. 2 station and the salt water intake from the Duncan Dock is being extended to the site of the new station. It was originally estimated that the new station would be in commission by 1954, but experts now have doubts whether sufficient structural steel will arrive in time to make this possible. Before the Dock Road station is demolished it will also be necessary to provide one or more large substations to take the place of transformers and switchgear now housed in the Dock Road station.

Shortage of Skilled Workers

The city electrical engineer stated recently that because of the scarcity of artisans, the generating efficiency of the plant at Table Bay power station had been reduced and was costing the city £15,000 a year more in coal. From the management point of view the position was just as serious as in June, when a blackout seemed imminent because of the coal scarcity. The power station was not being maintained as it should be and the situation was critical. They were faced with a constant threat of a breakdown and the possibility of having to shed load. Increased wages, from 3s 6d to 4s an hour, for municipal artisans had not yet resulted in vacancies being filled. There were at present fifteen vacancies in a staff of about 60. In 1951, 35 fitters and other engineering artisans had come and gone at the Cape Town power stations. Many of those who had left were long-service men who had been specially trained in power station work.

House Wiring

BLYTH Town Council's scheme for installing electricity in old Council houses served only by gas is being delayed by a shortage of materials. A petition signed by some of the tenants concerned has urged the Council to try and speed up the work, especially in view of the fact that for about twelve months the tenants have been paying an increased rent to cover the cost of the work.

South Shields Corporation Housing Committee recommends improvements to a further 380 pre-war houses on the Cleadon Park estate. The work includes renewing the electric wiring and the fitting of three-point plugs.

Infra-Red Car Drying

Installation at Vauxhall Factory

FOUR Metrovick infra-red drying ovens, arranged as two pairs, have been recently installed in the Luton factory of Vauxhall Motors, Ltd.

The completely assembled car is driven on to a floor-level chain conveyor which draws it through a washing booth where jets of water thoroughly test for screen and backlight leaks. After spraying the car is leathered down by hand, which leaves a thin film of moisture to be dried off in the first oven, through which the car passes in four minutes; the infra-red radiation is controlled to ensure that no part of the car exceeds a temperature of 180 deg F.

After emerging, the car travels 50ft, by which time it is completely dry, before entering the spray booth where spotting and touching-up are carried out with cellulose paint. A further travel of 20ft gives a flash-off period of about five minutes, before the car enters the cellulose drying oven, which is traversed in 3 min 20 sec, when the car emerges ready for final polishing and driving away.

The first infra-red plant, comprising two ovens side by side, is 17ft long, 24ft wide and 10ft high and has a total loading of 300 kW. Each oven incorporates 50 infra-red element projectors mounted in ten rows of five projectors per row. The element consists of a spiral of high grade heat-resisting wire tightly embedded in magnesium oxide, enclosed solidly in an outer sheath of a non-scaling and non-corrodible alloy. The trough reflector is made of aluminium sheet and anodized.

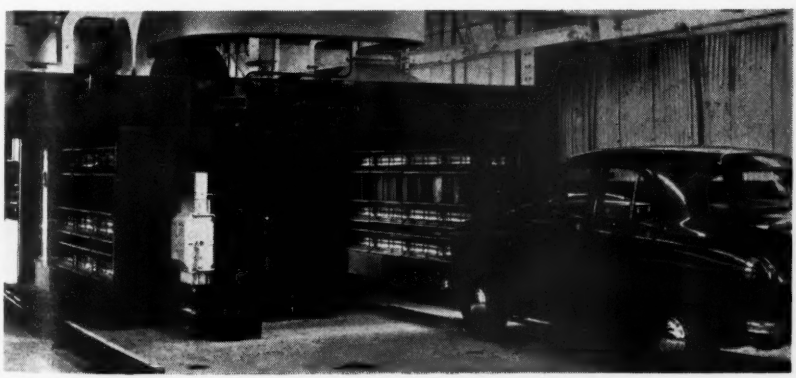
A separate air recirculating system, consisting of a centrifugal fan driven by a 2½ h.p. motor displacing 4,000 cu ft/min, drives air into each oven through ducts. Hot air is exhausted from the roof through three hoods extending the full length of the oven and linked by ducts to the suction side of the fan. The apertures in the lower ducts are louvred to direct the air stream on to the sides of the car.

Safety is ensured by electrical interlocking of conveyor motors and fans with the projectors; airflow switches, similarly interlocked with the projectors, ensure that the velocity reaches a safe minimum before the infra-red projectors can be switched on.

Panels of mild steel lagged with glass wool and finished on the inside with asbestos hardboard reduce heat losses. Heat output is controlled by Sunvic regulators.

The second plant is generally similar, except that it is 3ft shorter and has a total loading of 240 kW with ten rows of four projectors each.

Infra-red ovens for moisture drying plant at the Vauxhall factory



Industry and the House

Resumption of Business

By T. F. COOK, M.P.

THE House of Commons was getting into what was considered by many to be a very stormy pre-Budget session; the Butler axe had begun to hack at many cherished young trees which the previous Government felt were very firmly planted and were being nursed with particular care although they had been carefully pruned when required. Now the Opposition feels that the Government has given up any pretence of pruning or even of grafting and has decided quite flatly to chop them down.

There will be a major battle in the Commons on this issue. In the House the division bells are again ringing to summon members from all corners of a building so recently hushed because of the tragic loss to the nation, the loss of its King. As a mark of respect the Government decided to change the order of business to avoid party controversy this week although many members felt that the late King would have wished the normal business of his Parliament to continue in its ordinary way. He himself, in spite of medical advice, carried on with his heavy duties although he must have known that death was close to his side.

However, the decision has been taken to delay the political struggle which will surely arise from now right through and beyond the Budget. Many members and indeed many economists feel that the Government is now pursuing a full-blooded deflationary policy without counting the cost or even planning and preparing for the possibility of slump conditions. The indiscriminate cutting down of imports from Europe and elsewhere will have a devastating effect on the delicately balanced economies of other countries as well as our own. That is not to say that some cutting down was not necessary but very careful planning is needed to avoid the breaking down of what has taken six years of hard effort to build up. Members on both sides of the House are worried about the effect of the proposed economies, particularly the cutting of the health services.

Another delayed battle is on the second day's debate on foreign affairs. The Opposition felt very strongly on the question as to what had actually been decided at Washington in the light of Mr. Churchill's speech to Congress.

The Scottish Grand Committee was to debate this week, on the committee stage, the Bill authorizing the North of Scotland Hydro-Electric Board to obtain new capital. This will produce as usual a very lively debate. The rest of the business on the floor of the House consists of very little but routine stuff. Members will be mainly concerned with writing the speeches they hope to deliver in the big debates the following week. Members' lockers in the House of Commons are the graveyards of many undelivered brilliant orations.

Public Speaking Competition

THIS year there are nineteen area contests in England, Scotland and Wales in the E.D.A. Public Speaking Competition. This means that in the national finals there will be ten competitors in the women's section and nine in the men's section. First-prize winners of the contests held to date are as follows:—

Merseyside and North Wales Area:—Women: Mrs. Margery J. Conway, Liverpool. Men: Mr. I. McK. Douglas, Liverpool. South Wales Area:—Women: Miss Margaret Rees, Newport. Men: Mr. W. A. Harrison, Rhondda. South Western Area:—Women: Miss Elizabeth Crowther, Bideford. Men: Mr. A. J. Begbie, Torquay. London Area:—Miss Doris B. Sparrow, Hampstead. Eastern Area:—Miss Betty Addison, Barnet. Southern Area:—Miss Pamela H. Holden, Yeovil. London and Home Counties (to obtain sufficient male competitors to enable a contest to take place, the London, Eastern, South Eastern and Southern Areas had to combine):—Mr. G. W. Findlay, Southern Electricity Board, Ealing.

Contests are taking place as follows:—Women's Section: North Eastern, North Western, Scotland, and Yorkshire. Men's Section: East Midlands and Yorkshire (combined), Midlands, North Eastern, North Western, and Scotland.

Railway Illumination

Floodlighting of Industrial Sidings

By R. T. YATES*

A RAILWAY publicist, writing shortly before the first world war, who described a goods yard "partly lit by the powerful rays of lofty lamps," was stating a fact and not making an apology. The problems of adequate and uniform illumination on such premises had to await the development of new light sources and lighting methods for satisfactory solution, and the "long lines of shadowy trucks" to which the same writer referred in another passage were to remain a feature of the nocturnal railway scene for a long time to come.

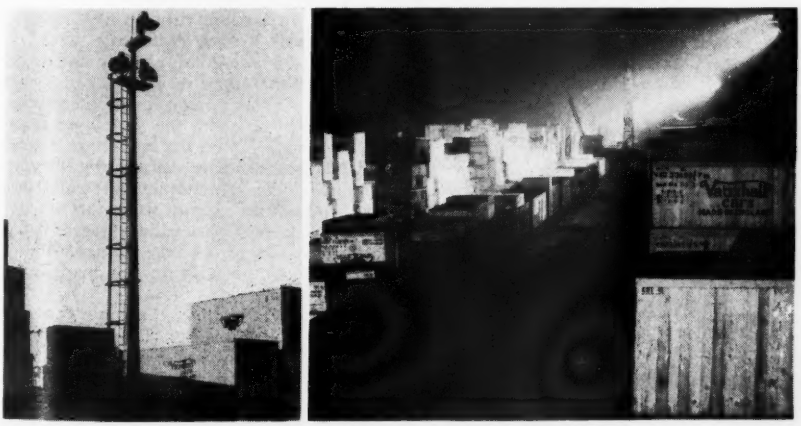
The subject is not of importance to railwaymen alone, for many industrial undertakings have their own sidings where to-day it is more important than ever, both to themselves and to industry as a whole, that wagon traffic should not be delayed by the slowing up of work after darkness falls.

There are various approaches to the problem of lighting sidings and the methods adopted must vary according to local circumstances. One consideration, however, applies irrespective of the size and situation of the sidings to be lighted. It is essential, for the convenience and safety of men working on the site, to avoid obstructions between the tracks so far as may be possible. Sometimes the use of mobile cranes running on the tracks in itself rules out the placing of poles between individual sidings. Another factor influencing the planning of a scheme is the situation of the sidings relative to adjacent running lines.

The illuminating engineer aims at providing light between the rows of wagons so that the wagons to right and left of each space between sidings are uniformly lighted. One way to achieve this object is by means of lights on poles at the end of the block of sidings, facing the spaces between sidings and aligned so that their beams are parallel with the tracks. As far as work in the sidings area itself is concerned, the main point to watch here is the choice of a mounting height sufficient to prevent glare due to direct observation

* Illuminating Engineering Department of the General Electric Co., Ltd.

Arrangement of floodlights on one of the concrete columns at the Oakleigh Park sidings of the Vauxhall factory and (right) night view in the working area of the motor car works



Good lighting does away with the "long lines of shadowy trucks" once characteristic of railway sidings

of the light sources. This is not as difficult as it sounds, as normal work in the sidings area mostly involves low angles of view.

On the other hand, if the sidings are parallel with, and close to, main railway lines, such a scheme will be inadmissible because the lights will be seen by drivers of trains approaching the site from one direction and may impair observation of signals, or actually be confused with them.

A method applicable to such situations is to light the sidings by means of floodlights on a row of poles along one side of the site, placed between the main lines and the sidings. One such scheme, now helping materially to maintain the flow of British motor vehicles for export, has been brought into use at the sidings of the Vauxhall Motor Co., Ltd., at Oakleigh Park, near Barnet. In those sidings, crated parts for the assembly of Vauxhall cars and Bedford commercial vehicles are received from the company's works at Luton by a service of special goods trains running via Hatfield. The crates, handled by steam cranes, are stacked, sorted and reloaded for despatch to the ports, these operations requiring more space than was available at the Luton factory. Some 500 wagons are handled in a week. To enable this work to proceed uninterruptedly during the darkness of winter evenings the Illuminating Engineering Department of the General Electric Co., Ltd., designed a floodlighting installation to provide a good working light all over the site without obstructing the spaces between the tracks.

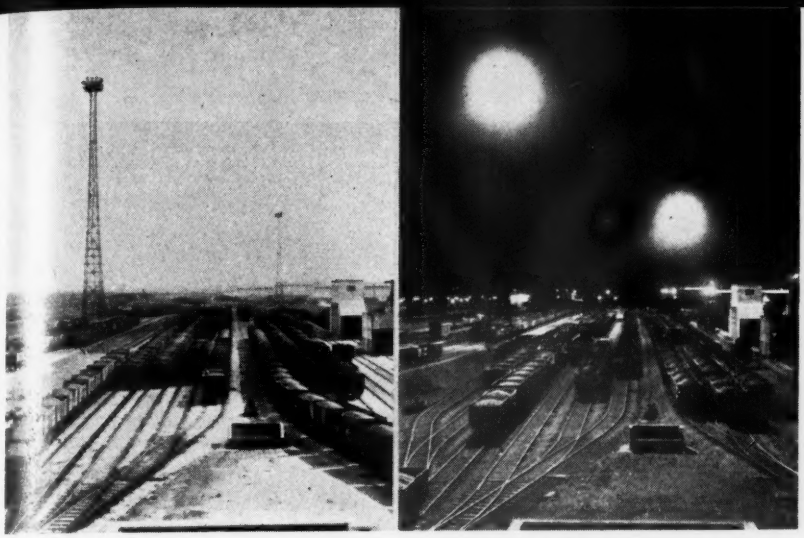
The sidings area is 400ft long by 200ft wide and is alongside the main line of the Eastern Region, British Railways, from Kings Cross to the north. Four Concrete Utilities columns, each supporting three standard G.E.C. floodlights (1,000 W tungsten lamps), are spaced 100ft apart in a row, parallel with the sidings and between them and the main line. The floodlights are directed across the sidings and the light distribution is such that there is a complete cut-off on the main-line side of the poles, so that there is no risk of the light being confused at a distance with the railway signalling installation. The scheme has received the approval of the railway authorities in this respect, and valuable assistance and co-operation were received from British Railways in its design.

Crates are stacked to a considerable height in the sidings area, but shadows are avoided by mounting the floodlights 50ft above ground level. With this arrangement the inscriptions and labels on crates and wagons can be read with ease all over the site; handlamps are no longer required, with a consequent gain in the speed of stacking and loading crates after dark.

Vertical surfaces of wagons and crates not illuminated directly by the units nearest to them receive light by reflection, and also direct from the floodlights facing in their direction on the more distant poles. The latter effect is assisted by the fact that the poles are not in a straight line, but follow the slight curvature of the railway where it passes the sidings. A row of poles at the back of the sidings, with the lights facing the railway, was inadmissible in this installation.

Local lighting for the points at the entrance to the sidings is provided by a 200 W lamp in a "Duoflux" reflector mounted on a 15ft pole.

Centralized switching for the floodlights



Floodlighting towers in steelworks sidings in Wales, day and night views

is arranged in an office building and enables one, two, or three units on any or all the poles to be brought into use so that light can be confined to a particular area where work is going on and adjusted to the level required. Ladders with safety hoops provide access to the floodlights.

The installation was carried out by Messrs. Holliday, Hall & Stinson.

An example of a similar principle adapted to particular local conditions is an installation at the Irwell Park wharf of the Manchester Ship Canal. The wharf covers, at present, an area measuring approximately 1,500ft by 150ft, one long side being formed by the canal itself. The usual cranes line the waterfront, while the ground area is covered by railway tracks and auxiliary dock installations. When a new lighting scheme was projected, three main requirements were laid down. First, columns were not admissible among the tracks, partly because of maintenance requirements and partly because of the risk of damage from crane-working. Secondly, any projectors or floodlights were to have a very sharp cut-off above the main beam, to avoid glare to the crane drivers in their cabins, some 20ft above ground level, and to traffic on the waterway. Finally, it was necessary to avoid obstructing vehicles using the roadway between the railway sidings.

To meet these requirements, the columns are ranged along one side of the wharf area and the upper parts of the cranes are

Lighting of the sidings (right) does not cause interference on the main lines (left) near Barnet

Cut-off lighting guards against glare in crane drivers' cabins (left) at the Irwell Park wharf of the Manchester Ship Canal

in comparative darkness. These results were obtained by using a modified form of G.E.C. airfield apron floodlight. The floodlights project a fan-shaped beam in the horizontal plane and are designed to provide adequate illumination beneath each unit (instead of the patchy effect often found) together with a very sharp cut-off. Normally used with a 1,000 W line filament lamp, those installed at Irwell Park have been equipped with 400 W mercury lamps burning horizontally.

The floodlights are mounted in pairs, at 200ft spacing, on Concrete Utilities columns at a mounting height of 40ft. The columns are fitted with steel access ladders so that maintenance problems are reduced to the minimum.

The results of the installation, planned by the Engineer's Department of the Manchester Ship Canal Company, have led to a decision to extend the use of this special equipment.

On some sites tall buildings in the sidings area may necessitate a much greater mounting height to avoid shadows than in the examples already quoted. At the Abbey Works of the Steel Company of Wales seven 150ft towers have been erected, on each of which groups of 1,000 W and 500 W floodlights have been mounted on the guard rails of the top platforms. The whole scheme employs 125 floodlights of 1,000 W and 30 of 500 W. The platforms and guard rails enable maintenance men to work in safety and with reasonable convenience while the concentration of a number of lights on each tower enables them to make full use of each ascent.

In the Abbey Works installation many of the floodlights are aligned approximately parallel with the tracks and light is projected in both directions from positions near the middle of each block of sidings. When such an arrangement can be used it is, perhaps, the simplest method of providing all the light desired between rows of wagons.

When restrictions are not imposed by nearby main lines on a sidings lighting scheme, a method known as "artificial moonlight" has been employed. The number of poles is kept small by mounting several lanterns on each and using high-powered mercury lamps.

The use of mercury or sodium light sources is naturally attractive for lighting sidings, but it raises problems of colour confusion with railway signals as well as those of avoiding glare and interference with the ease with which signal lamps can be picked out at a distance from other lights in their neighbourhood. Even with tungsten lighting a lower limit may be placed on the wattage of lamp used because of possible confusion between the yellowish light of the smaller wattages and the yellow "caution" aspect of railway signals. Examination of the site in relation to its surroundings and consultation with the railway authorities are necessary before a decision can be reached on the choice of light source for any installation.

Commerce and Industry

Sign Makers and Lighting Restrictions

Carlisle Undertaking's Assets

THE Minister of Fuel and Power has rejected requests by the Electrical Sign Manufacturers' Association that the restricted period on the use of electricity from the mains for advertising purposes should end at 1 p.m. The Minister has also rejected an alternative suggestion by E.S.M.A. that the restrictions should end at 5.30 p.m. as in February and March, 1950, in circumstances far less favourable than they are this year. The Ministry has given no reasons for the Minister's refusal but states that the matter is kept under review and that full account will be taken of the views of the Association.

Engineer-Managers

The Electrical Power Engineers' Association now has thirteen "managerial" sections to cater for members employed in a managerial capacity by the B.E.A. Divisions and the Electricity Boards. Through these the Association is represented on the staff side of the National Joint Committee together with representatives of the Association of Managerial Electrical Executive and the National Association of Local Government Officers. Mr. H. Norton, deputy general secretary of the E.P.E.A., has been appointed secretary of the staff side of the National Joint Committee by the three associations.

Wire Industry

The second edition of the "*Wire Industry* Encyclopædic Handbook," for 1952 is a useful guide to those engaged in making, fabricating and marketing wire. The seven sections include a buyers' guide and a classified arrangement of advertisers under wire mill supplies; machinery; wire supplies; and wire parts, springs and services. The encyclopædic section occupies over 150 pages and is arranged alphabetically. There are many useful appendices. The handbook can be obtained from *Wire Industry* at 33, Furnival Street, London, E.C.4, free to subscribers and £1 1s to non-subscribers.

B.E.A. Claim Against Carlisle

It was recently reported to the Finance Committee of the Carlisle Corporation that the British Electricity Authority was seeking a declaration from the High Court that certain assets held by the Corporation before electricity vesting date (1st April, 1948) became vested in the B.E.A. upon nationalization and should be transferred to the Authority. According to a report in the *Carlisle Journal* the claim relates to income tax charges made against the revenue of the former Electricity Department. The B.E.A. contends that amounts which should have been offset against income tax had not been taken into account and that a sum representing the accumulation of excess amounts was held by the Corporation, wholly or mainly in its capacity as an electricity undertaker. This sum therefore vested in the British Electricity Authority under the Electricity Act, 1947. The Finance Committee had been advised to resist the claim and recommended the Council to give it power to take the necessary action.

Machinery Trades Convention

The third annual convention of the Association of Electrical Machinery Trades will be held at the Chateau Impney, Droitwich Spa, Worcs, on 21st and 22nd April next. On the first day the Council meeting will be held in the morning, and following lunch, a paper will be presented on "Design of Motors." There will be a dinner and a smoking concert in the evening. On the second day a paper will be presented in the morning on "Developments in Electronic Control of Motors," followed by a luncheon. A visit to the Shakespeare Memorial Theatre, Stratford-on-Avon, and a golf tournament are proposed for the afternoon. Wives of members are invited to attend the convention.

Trading in Lead

The Chancellor of the Duchy of Lancaster on 11th February received a deputation from the Committee of the London Metal Exchange to discuss the possibility of a return to private trading in lead on the London Metal Exchange. He promised to give careful consideration to the views expressed.

Mine Fluorescent Lighting

One of the largest installations of electric power and lighting equipment in the mining industry has recently been completed in the Eregli Coal Mines, Turkey. Last year engineers from the British Thomson-Houston Co., Ltd., were sent to the Eregli mines to advise on the installing of more than 700 flameproof underground mining units and 3,500 flameproof fluorescent lighting fittings. At the same time

as B.T.H. engineers arrived in Turkey the Turkish authorities took advantage of facilities offered by B.T.H. to train twelve of their personnel in the operation and maintenance of the equipment. Training schools in elementary mechanics had to be organized by B.T.H. for the erection and continued maintenance of the equipment.

Mr. D. Creeth, Graduate I.E.E., who was one of the first B.T.H. engineers on the spot, helped in the training of miners and also acted in an advisory capacity to the central group which has now been set up by the Turkish authorities to control the mines.

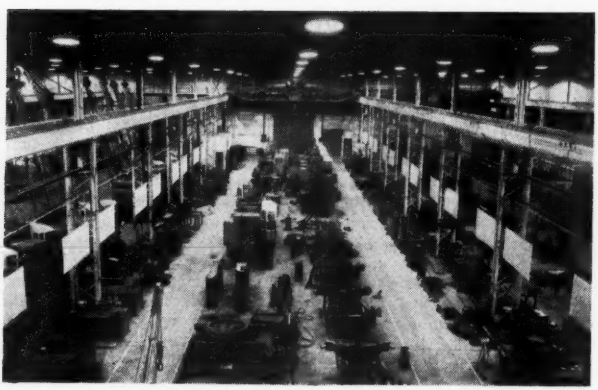
Work of the G.P.O.

There is much of electrical interest in "Post Office, 1951" (H.M. Stationery Office, 3s), an account of the Department's many activities. The publication takes the form of a series of illustrated articles by members of the staff. One is "The Romance of the Inland Trunk Service" by Col. J. Reading, assistant engineer-in-chief, which describes the growth and present-day position of the telephone service with simple descriptions of the many devices employed in its operation. Another contribution, by Capt. W. H. Leech (P.O. Submarine Superintendent), tells the story of the Post Office cable ships with particular emphasis upon their work during the war. Other aspects of the telegraph and telephone services also form the subjects of articles.

Planned Factory Lighting

K & L Steelfounders & Engineers, Ltd., have recently completed the lighting installation in their new factory extension at Durham Lane, Letchworth. The accompanying picture shows some of the seventy-two Ediswan overlamp dispersive reflectors which were used throughout, each having a 1,000 W "Royal Ediswan" lamp, giving an average service intensity of 16 lumens/sq ft on a working plane 3ft above the floor. The installation was carried out by K & L Steelfounders' own engineering staff and A. E. Ratcliff, Ltd., of Hitchin.

Ediswan reflectors and lamps are installed for the lighting of the new factory at Letchworth of K & L Steelfounders & Engineers, Ltd.



Contract for Traction Rectifiers

In connection with the re-equipping of parts of the western section of the Southern Region of British Railways the Hackbridge and Hewittic Electric Co., Ltd., has received an order for the supply of 120,000 kW of glass bulb rectifiers consisting of forty-eight 2,500 kW sets. These will be installed in twenty-nine substations having individual capacities of from 2,500 kW to 10,000 kW for feeding the main and suburban traffic lines from Waterloo station to Hampton Court junction and branch lines to Guildford, Staines and Windsor, etc. The incoming supply will be 33 kV and the output to the track 660 V d.c., but provision is to be made for the equipment to operate at 750 V d.c. at a later date.

The company's rectifiers have been in railway traction service since 1932 and now an aggregate capacity of over 111,000 kW of this equipment is supplying traction loads in the Greater London area. The British Railways' contract, and others in hand, will increase this total to almost a quarter of a million kW in this area alone.

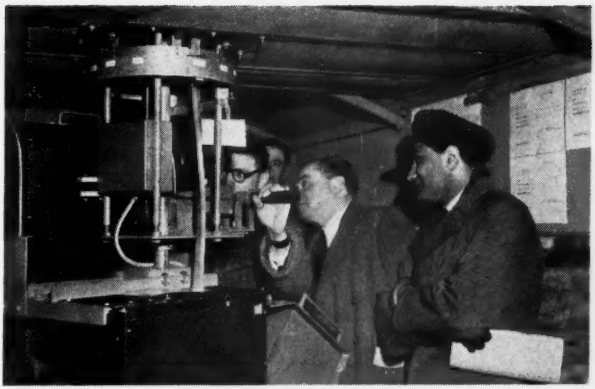
Alleged Pollution of River

The British Electricity Authority was one of the defendants in a claim for an injunction and damages made last week in the Chancery Division by the Pride of Derby and Derbyshire Angling Association, Ltd., and the Earl of Harrington. The claimants alleged that the Authority, British Celanese, Ltd., and the Derby Corporation had polluted the River Derwent and made the part with which the claimants were concerned valueless as a fishery. It was stated that Midland Tar Distillers, Ltd., who had been among the defendants, had now ceased the operations complained of and proceedings against them had been stayed. British Celanese, Ltd., was prepared to submit to an injunction but might apply later for a suspension.

The British Electricity Authority, which used the river water for cooling purposes, was

said t be returning it in a ated condition which art from raising the perature, encoura the growth of fung to the detriment the fish.

The ritish Electricity Auth ty denied that its charge appreciabl increased the temp ature of the wate Its Counsel contende that the effect was mitigate rather than crease the pollution the river and the bree g of fish was helpe His clients were prepared to consider whether they could do anything to help the plaintiffs but it would involve considerable time and expense. The case was still proceeding when we went to press.



Demonstrating an "Ekco" airfield radio approach aid at Southend

Taxation of Trading Profits

A memorandum on the "Computation of Profits for Taxation Purposes," being a commentary on the report of the Millard Tucker Committee, has been published by the Federation of British Industries. In the course of this, methods of countering the effects of inflation upon the replacement of plant are considered. One suggestion made is that additional allowances (kept quite distinct from the normal wear-and-tear allowances) should be deducted from the year's profits to take account of rising replacement costs.

Sale of Lead to the United States

The Ministry of Materials announces that, with the agreement of the Canadian and Australian Governments and producers, 30,000 tons of lead supplied under their current contracts with the Ministry have been re-sold and will be delivered to the United States during the next four months. Prices will be equivalent to the current price for foreign lead in the United States.

Old "M.K." Catalogues

Towards the end of last year the M.K. Electric Co., Ltd., offered a prize for the oldest of its catalogues to be sent in. The company now tells us that the prize has been awarded to F. & C. Osler, Ltd., Export Department, Birmingham.

Airfield Radio Approach Aid

A demonstration of the prototype of the latest "Ekco" airfield radio approach aid was demonstrated at Southend Airport on 4th February, and was attended by a number of distinguished visitors from many parts of the world. In the accompanying picture we show Mr. E. K. Cole (centre) watching Mr. B. Collins, Southend Airport manager, operating the apparatus. On the right of the picture is S/Ldr. K. S. Chopra, air adviser to the High Commissioner for India.

Imports into Germany

The *Board of Trade Journal* of 16th February contains schedules of goods which may now be imported into the Federal Republic of Germany without restriction. Boiler plant and electrical equipment, appliances and accessories of many kinds are included in the lists.

Hoover's in Finland

A party for the Press and official guests was held last week in Helsinki, Finland, by Hoover, Ltd., London, Havulinna Oy, Helsinki, and W. Rosenlew & Co. Oy, of Bjorneborgs, at which these concerns announced an arrangement whereby W. Rosenlew & Co. Oy will assemble Hoover washing machines in Finland, while Havulinna Oy will distribute them as hitherto. Representatives from Hoover, Ltd., were Mr. V. C. Mumford, deputy export manager, Mr. W. M. Tribute, advertising and publicity manager, Mr. W. M. Thompson, Scandinavian divisional manager and Miss M. Cowan, export washing machine consultant.

Fruit Orchard Fatality

Gloucestershire National Farmers' Union Publicity Committee has considered a letter from the Midlands Electricity Board replying to the complaint concerning a recent fatal accident caused by a worker touching a high-voltage cable with an aluminium ladder he was using in a fruit orchard.

The Board stated that the statutory minimum

clearance was 20ft. The cable referred to was 25ft from the ground. The aluminium ladder used was 27ft long. It was recommended that wooden ladders be used near electric cables but warned that even these might prove dangerous when wet.

A member, Mr. F. Pullin, was not satisfied, saying that all high-voltage cables running over orchards should be insulated and bare wires not used.

Prices of Materials

In the accompanying table we give the prices of the more important materials used in the electrical industry. The figures are those quoted on Monday last.

ALUMINIUM Ingots	ton £148 0s 0d
COPPER, H.C. Electro	ton £227 0s 0d
Fire Refined 99·7 per cent ..	ton £226 0s 0d
Fire Refined 99·2 per cent ..	ton £225 10s 0d
COPPER Tubes	lb 2s 2d
Sheet	ton £280 0s 0d
H.C. wire and strip	ton £254 0s 0d
LEAD, English	ton £171 10s 0d
Foreign	ton £170 0s 0d
MERCURY	flask £73 10s 0d
TIN	ton £978 0s 0d
ZINC, G.O.B. Foreign	ton £190 0s 0d
Electrolytic	ton £194 0s 0d
BRASS Tubes	lb 2s 1d
Sheet	lb 2s 4½d
Wire	lb 2s 7½d
PHOSPHOR BRONZE	
Wire	lb 3s 7½d
RUBBER, No. 1 R.S.S. spot ..	lb 33d–33½d

Price Index Numbers

The Board of Trade's price index number for materials used in the electrical machinery industry reached a new high level in January, the figure being 160·0 (1949 = 100), against 159·0 in December and an average of 151·9 for last year.

Trade Announcements

From 3rd March next the address of the Manchester depot of **Davidson & Co., Ltd.**, of Belfast, will be 42, Deansgate, Manchester, 3 (telephone : Blackfriars 6218).

The construction of the new factory and offices at Hemel Hempstead of **Multicore Solders, Ltd.**, is now complete, and from 25th February all correspondence, etc., should be sent to the company at Multicore Works, Maylands Avenue, Hemel Hempstead, Herts (telephone : Boxmoor 3636). The company's West End offices are being retained only as executive offices.

"Manufacturing Progress—1951"

Two errors occurred in "Manufacturing Progress—1951" (15th February issue). Among the orders received by Foster Transformers & Switchgear, Ltd., was one for fifteen transformers of 2,000 kVA for 44 kV (not 4·4 kV) for the Hydro-Electric Power Commission of Ontario. The Crypton "electric hydrometer" for measuring the state of charge of a battery is named "Hydrolek."

Catalogues and Lists

Standard Telephones & Cables, Ltd., Remote Control Department, Oakleigh Road, New Southgate, London, N.11.—Illustrated technical brochure on rotary semaphore keys (D/RC.15).

Crypton Equipment, Ltd., Bridgwater, Somerset.—Price list SG152 of "Foster H.I." heavy industrial fuse switches.

Simplex Electric Co., Ltd., Broadwell, Oldbury, Birmingham.—Commercial lighting fittings specification folder.

English Electric Co., Ltd., Stafford.—Two technical publications on high-voltage switching stations and hot strip mill equipment.

International Combustion, Ltd., 19, Woburn Place, London, W.C.1.—Illustrated technical booklet on coal milling and pulverized fuel firing (W513).

Morgan Crucible Co., Ltd., Battersea Church Road, London, S.W.11.—Illustrated sales literature on "Triangle" pure oxide ware (RD3).

British Insulated Callender's Cables, Ltd., Norfolk House, Norfolk Street, London, W.C.2.—Fifty-page illustrated publication on bolted flameproof couplers (310).

Bylock Electric, Ltd., 109, South Street, Ponders End, Middlesex.—Four illustrated priced leaflets on spray guns, spray units and hand dryers.

Edison Swan Electric Co., Ltd., 155, Charing Cross Road, London, W.C.2.—Illustrated technical booklet on telephone line protectors.

Information Department

THE extensive records of our Information Department enable us to reply to most queries, but occasionally we ask our readers' assistance in tracing names and addresses not known to us. We should be glad to have such information regarding the makers of the following:—

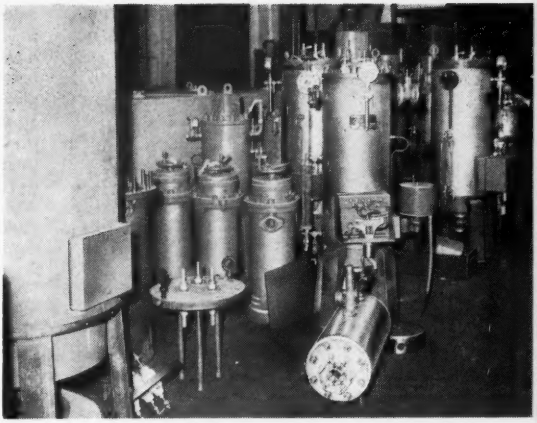
"Wesco" rotary switches.

"Paprex" finishes for insulated cable.

General inquiries from readers relating to sources of electrical goods, makers' addresses, etc., are replied to by the Information Department through the post. Inquiries should be accompanied by a stamped addressed envelope.

Water Heater Production

Developments at Bastian & Allen's New Works



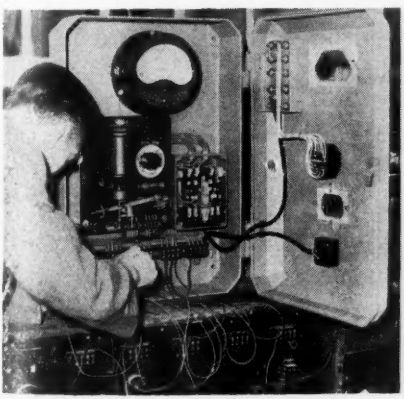
Group of steam raisers with water boilers on left

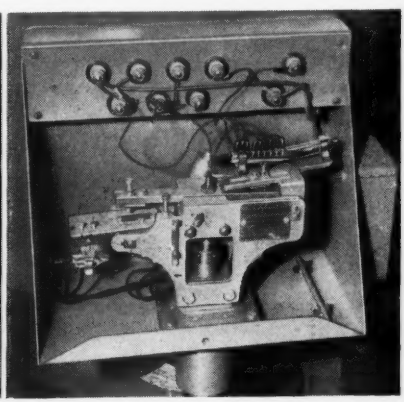
THE transfer of production just over two years ago from St. Pancras Way, N.W.1, to Ferndale Terrace, Harrow, has enabled Bastian & Allen, Ltd., not only to increase their output of existing products but also to develop new ideas in water heating and steam raising and to expand the space heating side of the business. With a floor area of 25,000 sq ft, the new factory is 70 per cent larger than the old premises, and plans in hand will add a further 5,000 sq ft of production space, still leaving room for at least another 20,000 sq ft extension on the adjoining site.

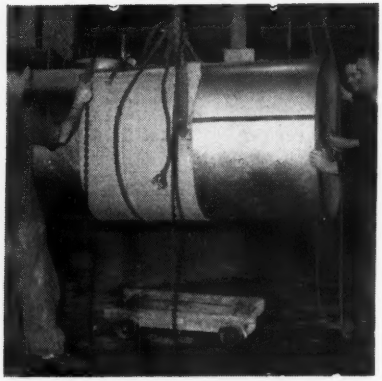
It is nearly a quarter of a century since the company first entered the electric heating industry and in its endeavours to develop new and improved applications of electricity it has been responsible for many important advances in large-scale electric heating, being, it is claimed, the first manufacturer of electrode boilers in the country.

Though representing only one side of the company's business, electrode boilers are perhaps the product for which the company is best known, its output being the largest in the country. Types both for steam raising and water heating are available with loadings from 30 kW to

Testing an electrode boiler control panel and (right) new pressure modulator







150 gall thermal storage water heater incorporating 18 kW of immersion heaters at the bottom and 6 kW a third of the way from the top

10,000 kW (high voltage over 1,000 kW) with respectively either a steam output of from 100 lb to 33,500 lb/hr or a heat output of from 102,000 to 34,000,000 B.Th.U./hr. Basically the designs of the steam raising and water heating units are the same, but the former have their electrodes at the top, the load being varied by the water level, while the water boilers have the elements at the bottom, insulating sleeves being raised or lowered over them. Up to 100 kW the load control of the water boilers, which are employed largely for space heating and hot water service, is hand set: larger units are equipped with hydraulic load control so that the load is always reduced to the minimum before the current is broken. A new system of pressure modulation recently introduced provides for an alteration of as little as ±1 sq in in pressure to vary the load from 10 to 100 per cent.

Another new development, which can conveniently be used in conjunction with an electrode steam boiler, is the "Vapor Phase" unit for use with diesel engines. Water in the engine jacket is circulated by a pump or gravity through the "Vapor Phase" unit at a temperature of 240 deg F (10 lb/sq in). The pressure being slightly lower than that in the jacket the water flashes into steam, which is separated and can be utilized for low pressure space heating, cooking, etc. On occasions the steam available may be inadequate for the purpose required and an electrode boiler can be arranged to make up the deficiency automatically.

Over half the company's output is destined for overseas, among the best markets being Canada, Brazil, South Africa, the Rhodesias, British West Africa, Belgian Congo, India, Australia, New Zealand and Tasmania. Among the orders received from the last-mentioned country is a particularly interesting one for the

A batch of drying ovens being finished

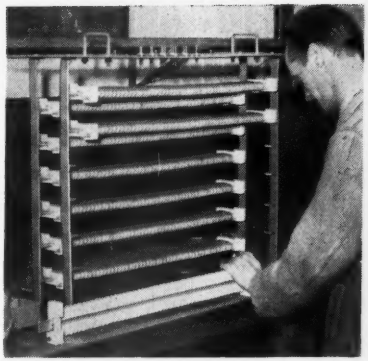
Electrolytic Zinc Co., Ltd. Two electrode steam boilers each rated at 1,000 kW will be controlled from the main 44 kV incoming supply to the factory so that the boiler and factory load will never exceed a given maximum demand, with consequent improvement in load factor. Five 1,000 kW electrode steam boilers were supplied recently to a textile factory in Portuguese East Africa and two 900 kW boilers, together with an air heater rated at 3,[illegible] kW, were supplied to Uganda for a grain drying project.

At home the Knightstone Baths, Weston-super-Mare, are being converted to electricity and the existing Lancashire and Cochrane solid fuel fired boilers are being replaced. Three hot water boilers and one steam boiler with loadings of 30 kW, 60 kW, 200 kW and 150 kW, respectively, are being installed for heating the swimming pool water, slipper baths and space heating. Steam boilers are being supplied for process steam raising in a wide variety of industries. Hot water boilers and thermal storage equipment are being installed in North Tees, Bromborough and Brighton "B" power stations and the new B.E.A. offices at Birchgrove, Cardiff.

Special boilers for train heating are being called for in increasing numbers. Thirty 300 kW units to operate on 3,000 V d.c., at 70 lb/sq in, have been incorporated in electric locomotives with Metropolitan-Vickers traction equipment for the South African Railways. Others have been supplied to operate on 600 V d.c. with English Electric equipment and used for some years on the British Railways, Southern Region. Fifteen boilers are at present being made for British Railways to incorporate in their locomotives with Metropolitan-Vickers traction equipment for the Manchester–Sheffield electrification.

Apart from electrode boilers the company has a big business in water heaters, incorporating immersion type elements, air heaters of various kinds, superheaters, drying cabinets, etc. Except for castings and such components as motors, coils and accessories the works are virtually self-contained and all machining, assembly of control panels, pumps, manufacture of relays and magnetic valves are carried out on the premises.

In general, batch production has been adopted, apparatus being brought to a certain stage ready for completion to meet customers' requirements as regards such items as mounting arrangements, safety valves, etc.



Assembling an air heater

British Standards

Turbine Gears

THE first part of B.S. 1807, issued in the preparation of B.S. 1498 on gear hobbing machines for toroidal and similar drives, concerns the accuracy of high grade gears used in the drives for turbine and similar plant. It deals with the nomenclature of double reduction gear trains and the accuracy of reference surfaces on the blanks. A section relating to wheels and pinions deals comprehensively with the permissible errors for undulations, transverse pitch, axial pitch, tooth thickness and backlash. Part 2 will deal with tooth form and gear loading.

Aerodrome Lighting

There has been a further revision of B.S. 1332, guide to civil land aerodrome lighting, probable future requirements and equipment. It has the approval of the Ministry of Civil Aviation, due consideration having been given to the third and fourth sessions of the Aerodrome Air Routes and Ground Aids Division of the International Civil Aviation Organization, documents No. 4809 AGA 558 and No. 6932 AGA 590. It gives information on beacons, approach, threshold, runway, taxiway, obstruction and boundary lights; in addition it deals with floodlights, traction indicators, ground traffic signalling lights and portable and emergency lighting. A diagrammatical arrangement of lights on an aerodrome is included, together with appropriate graphical symbols.

Copies of these specifications may be obtained from the British Standards Institution, 24, Victoria Street, London, S.W.1, price 3s 6d and 3s, post free, respectively.

Malaya's Electrical Imports

Statistics for First Half of 1951

THE electrical import trade of Malaya in the first six months of 1951 is shown by the official statistics to have been active and progressive in spite of serious troubles. It was also highly competitive.

The accompanying table gives the values of the principal groups in the period under review, with notes of increases or decreases on the first half of 1950. Noteworthy increases were in wires and cables (except telegraph and telephone), batteries and accumulators, and refrigerators and parts. In the trade in fans, India and Japan gained ground from the United Kingdom. The Malayan dollar equals 2s 4d.

Class of Equipment	Jan.-June, 1951 $ (000)	Inc. or dec. on Jan.-June, 1950 $ (000)
Convertors and transformers	326	− 58
From U.K.	299	− 83
„ *Japan*	27	+ 27
Generators	1,226	+ 988
From U.K.	1,143	+ 971
„ *U.S.A.*	51	− 15
„ *Australia*	19	+ 19
Motors 25 h.p. and under	390	+ 11
From U.K.	332	− 22
„ *U.S.A.*	38	+ 20
Motors 25 h.p. to 100 h.p.	115*	+ 1
Motors over 100 h.p.	88*	− 59
Switchgear	620*	+ 18
Other electrical machinery	528	+ 121
From U.K.	470	+ 91
„ *Germany*	44	+ 44
„ *U.S.A.*	7	− 21
Automobile lamp bulbs, etc.	91	+ 18
From U.K.	21	—
„ *U.S.A.*	41	+ 6
„ *Holland*	10	− 6
„ *Japan*	11	+ 11
Flash, radio panel and cycle dynamo bulbs	676	− 90
From Holland	141	+ 32
„ *U.S.A.*	305	− 223
„ *Hongkong*	198	+ 102
„ *Japan*	18	+ 18
Fluorescent lamps (not h.v.)	163	+ 48
From U.K.	72	+ 42
„ *U.S.A.*	73	+ 22
„ *Holland*	15	− 8
Electric lighting accessories	1,093	+ 168
From U.K.	840	+ 118
„ *Australia*	17	—
„ *U.S.A.*	63	− 24
„ *Hongkong*	76	+ 31
„ *Holland*	37	− 15
Wires and cables, not telegraph or telephone, rubber insulated	1,159	+ 98
From U.K.	1,133	+ 92
„ *Italy*	22	+ 19
Ditto, insulation other than rubber	1,667*	+ 208
Ditto, telegraph and telephone	601*	− 216
Ditto, other	645*	+ 292
Electro-medical apparatus, X-ray and vacuum tubes	49	− 137
From U.K.	39	− 44
„ *U.S.A.*	8	− 65
Ammeters, voltmeters and other commercial electrical instruments	165	− 16
From U.K.	139	− 31
„ *Germany*	8	+ 8
House service meters complete	277*	+ 149
Electrical refrigerators and parts	2,051	+ 908
From U.K.	1,243	+ 578
„ *U.S.A.*	778	+ 303
Electric flat irons	239*	+ 145
Electric fans	880	+ 43
From U.K.	689	− 120
„ *India*	122	+ 116
„ *Japan*	57	+ 52
Accumulators	2,242	+ 1,005
From U.K.	1,591	+ 641
„ *Germany*	306	+ 235
„ *Australia*	229	+ 22
Batteries	113	− 9
From U.K.	104	+ 27
„ *Australia*	8	− 34
Ditto for hand flash lamps	1,573	+ 1,210
From Canada	717	+ 663
„ *U.S.A.*	466	+ 311
„ *Hongkong*	356	+ 274
„ *U.K.*	25	− 35
Radio transmitting sets and communication apparatus, including radar, excluding valves	962	†
From U.K.	915	—
U.S.A.	42	—
Transmitting and industrial valves	175*	†
Other valves	161	—
From U.K.	129	—
„ *Holland*	31	—
Radio telecommunication and electronic apparatus, other parts and accessories	602	†
From U.K.	503	—
„ *Holland*	79	—
„ *U.S.A.*	7	—
Telegraph and telephone apparatus other than radio	1,881*	− 227
Electric cooking and heating appliances	346	− 7
From U.K.	311	− 29
„ *Canada*	21	+ 13
Electrical goods and apparatus n.e.s.	1,478	+ 398

* Mainly from U.K.

† Comparative figures not available.

Magnetizing Force in the Axis of a Coil

New Method of Calculation

By A. A. HALACSY, D.Sc.(Eng.), A.M.I.E.E.

A NEW method published elsewhere* is a practical prescription for the calculation of the magnetizing force H at any point in empty space due to an electric current. Referring to Fig. 1, the procedure is to draw the radii vectors r from the point O where H is required to the points on the path of the influencing current I, measuring the length $\rho = 1/\sqrt{r}$ in each r direction. It is easy to imagine how these ρ radii vectors sweep over a surface when r swings from the beginning to the end of the influencing section of the circuit. It should be noted that the surface must be considered positive or negative according to the clockwise or anticlockwise movement of ρ. If this surface is projected on a plane normal to the direction z in which the component of the magnetizing force is wanted then the double area $2A_z$ of this projection multiplied by the current I equals the component of the magnetizing force normal to the plane.

$$\text{Thus } H_z = 2IA_z \ldots\ldots\ldots (1)$$

All three components of H can be worked out in similar fashion in the three directions of the space, their geometrical sum giving the numerical value and direction of the magnetizing force H at the point O.

The method may be used both graphically and analytically and it simplifies the handling of some complex problems. For example, the axial component of the magnetizing force in the centre of a coil can be determined. The lower half of the coil is neglected due to the symmetrical arrangement and H_z is found by doubling the value calculated from the upper half only. Fig. 2 shows that

$$r = \sqrt{\left\{\left(\frac{D}{2}\right)^2 + \left(\frac{D}{2}\,\alpha\,\phi\right)^2\right\}} = \frac{D}{2}\sqrt{\left(1 + \alpha^2\,\phi^2\right)} \ldots\ldots\ldots (2)$$

where $\alpha = d/D\pi$, d is the axial distance between two adjacent turns, and D the mean diameter of the coil.

In order to calculate the component H_z pointing in the direction of the centre line Z the surface swept over by $\rho = 1/\sqrt{r}$ has to be projected on the xy plane set in the point O and normal to the centre line Z.

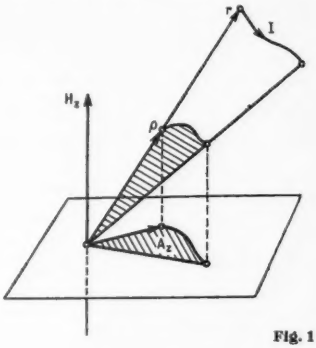


Fig. 1

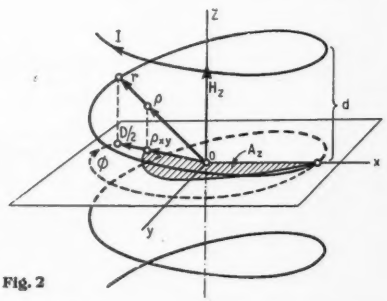


Fig. 2

Obviously the projected area is swept over by the projection of ρ on the xy plane.

* A. A. Halacsy : "Practical Calculation of Magnetizing Force," *Proceedings* of the Institution of Electrical Engineers, Vol. 97, Part I, No. 104, March, 1950.

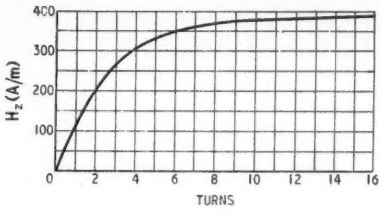


Fig. 3

This projection ρ_{xy} can be proved as being

$$\frac{D}{2} \Big/ r^{\frac{3}{2}} = 1 \Big/ \left\{ \left(\frac{D}{2}\right)^{\frac{1}{2}} \left(1 + \alpha^2 \phi^2\right)^{\frac{3}{4}} \right\} \quad \ldots (3)$$

The projected area, that is the one swept over by ρ_{xy} and derived from the upper half of the helical coil is

$$A_z = \int_0^{\phi} \tfrac{1}{2} \rho_{xy}^2 \, d\phi \quad \ldots (4)$$

The combination of equations (1) and (4) gives the magnetizing force due to the upper half of the coil

$$H_{z\,\text{upper}} = 2I \int_0^{\phi} \tfrac{1}{2} \rho_{xy}^2 \, d\phi, \text{ which on}$$

substituting equation (3) for ρ_{xy}, becomes

$$\frac{2I}{D} \int_0^{\phi} \frac{d\phi}{(1 + \alpha^2 \phi^2)^{\frac{3}{2}}} \quad \ldots (5)$$

Twice of this value is the magnetizing force due to the complete coil and working out the integral

$$H_z = I \frac{4}{D} \frac{\phi}{\sqrt{(1 + \alpha^2 \phi^2)}} \quad \ldots (6)$$

Introducing the denotation L for the length of the coil and N for the total number of turns—

$$\phi = 2\pi N/2 = \pi N \quad \ldots (7)$$

$$\alpha = d/D\pi = L/D\pi N \quad \ldots (8)$$

Combining equations (7) and (8) $\alpha = \pi NL/D\pi N = L/D \quad \ldots (9)$

Therefore $\alpha^2 \phi^2 = L^2/D^2 \quad \ldots (10)$

Combining equations (6) and (10) $I = I\,4\pi N/\sqrt{(D^2 + L^2)} \quad \ldots (11)$

and this is valid for any, even *fractional* numbers of turns.

Fig. 3 shows the values of H_z against numbers of turns, for $\alpha = 0{\cdot}1$ and $D = 0{\cdot}1$, unrationalized M.K.S. units being used.

The result may be checked in the case of an "infinitely long" coil by transcribing equation (11) as follows—

$$H_z = I \frac{4}{D} \frac{\phi}{\sqrt{(1 + \alpha^2 \phi^2)}} = I \frac{4}{D} \frac{1}{\sqrt{\left(\frac{1}{\phi^2} + \alpha^2\right)}} \quad \ldots (12)$$

An increase in the number of turns to the infinite, i.e., $N \to \infty$ and $\phi \to \infty$ reduces equation (12) to

$$\frac{H_z}{\phi \to \infty} = I \frac{4}{D} \frac{1}{\sqrt{(0 + \alpha^2)}} = 4I/D\alpha \quad \ldots (13)$$

Taking the value of α from equation (8)

$$H_z = I\,4\pi N/L \quad \ldots (14)$$

which is the well-known formula of H_z for an "infinitely long" coil.

The graphical solution of the same problem was presented in the author's paper which was presented in the I.E.E. *Proceedings*. The analytical solution results in the simple formula presented here.

Kafue Hydro-Electric Scheme

Error in Calculation

OUR Cape Town correspondent says that the Kafue hydro-electric project sponsored by the Northern Rhodesian Government has run into trouble. The chairman of the Territorial Electricity Development Committee recently told the Legislative Council that an error of 105ft had been made in the calculation of the difference in the level between the railway bridge—14 miles upstream—and the dam wall site. This might seriously hamper the Government proposals. Until recent investigations, the fall between these two points had been considered to be 200ft; it was in actual fact 95ft. All investigations to date had been based on a fall of 200ft. He said: "This does not mean that the entire scheme must go by the board. Naturally, the magnitude of the scheme must be affected in its initial stages." A contour survey would show the true volume of water that could be conserved. The original error occurred when a figure of 200ft was taken from maps compiled by aerial surveys. It was realized at the time that a reasonable margin of error had to be allowed for in an aerial survey.

When in Cape Town recently, Sir William Halcrow said that this error should not materially affect the power scheme. He remarked: "The river in the Kafue Gorge is only now being surveyed and any tentative scheme for hydro-electric development is elastic and can be adapted to the actual conditions revealed by accurate survey."

Engineering in Europe

Survey of Current Literature

THE only argument that can be advanced in favour of the conventional type of cable junction box, a particularly bulky and "material-wasting" contrivance, is that it enables cable-jointing operations to be carried out by "less skilled" personnel, but this is only a fallacy. Men handling h.v. equipment must be trained, anyway, and it is easy to prove that with a good knowledge of the structure of the particular cable type the operator will not experience too much difficulty in imitating the type structure at the joint and producing manually over a short length what the cabling machinery achieves for the whole length of the cable.

Of course, some additional materials, such as short lengths of slotted plastic and lead sleeving, are required, but this cannot compare with the considerable quantity of comparatively expensive materials and the labour going into the production of a junction box. The saving of space is an added advantage.

Tests carried out on properly made cable joints of this kind have shown that their mechanical strength may exceed that of the cable itself and that the electrical strength may be raised to resist sustained tests at 35 kV without breakdown (this referring to joints on 1 kV cables).—"Metal Saving by the Use of Cable Joints without Junction Boxes," E. Dörfel, *Elektrotechnik*, Vol. 5, No. 10, pp. 445–448, October, 1951, in German.

"Slow" Circuit Breaking

The influence of the separating speed of an opening circuit breaker on the phenomena leading to the definite extinction of the arc at the first natural current zero, or to its re-ignition for successive half-periods, has been investigated. The work was confined to one experimental circuit breaker with a break of 8 mm, contacts of the shape of spherical caps of silver, without devices for producing blast or carrying off the arc, and a variable separating speed.

The currents during the experiments were of the order of some tenths of one ampere; the voltages were up to 500 V at commercial frequency and at power factors between unity and zero. The minimum time required for the whole travel of the moving contact was a fraction of a half-period of the current, the maximum of the order of some tens of half-periods.

Theoretical considerations and experiments agreed on the fact that the "slow" interruption, i.e., an interruption of a duration considerably exceeding a half-period, is more favourable than the "rapid" rupture corresponding to times of travel of the order of one-half a period or less for the purpose of obtaining definitive arc extinction at the first, or at least at the second, natural current zero.—"The 'Slow' Circuit Breaking of Moderate Alternating Currents at Low Voltage," S. B. Toniolo, *L'Elettrotecnica*, Vol. 38, pp. 498–504, 10th–25th November, 1951, in Italian.

Line Protection

The protective equipment on h.v. lines has to (1) render the voltage distribution over the insulator chains uniform; (2) protect the insulation against cascades of impulse discharges; (3) keep the follow-up arc of commercial frequency away from the insulation. However, it is not always necessary that the protection of a certain line shall satisfy all these conditions simultaneously, because mostly one condition will be of predominant importance, according to the line parameters.

The results of comprehensive investigations of corona stresses on insulators and the influence of protective equipment may be summarized thus:—

(1) *Lines at 220 kV and more:* protective equipment is necessary only for balancing the voltage distribution over the chains and for reducing the stresses on the first insulator element (from the conductor). Protection

Readers who require accurate full translations of any of the articles abstracted in this section can be put into touch with the translators who will supply them at current rates.—Editors, *Electrical Review*.

for preventing cascade discharges is hardly necessary, because an impulse discharge set up by a direct lightning stroke is improbable on a line at the high protection level of a h.v. line. Arc-diverting gear on the insulator chains would not serve its purpose, because it would take more time to divert the arc than to cut out the line.

(2) *Transmission lines at* 110 *and* 35 *kV:* those on wooden poles do not require protection. For lines on metal masts, gear to divert the power arc is required to prevent the insulators and conductors suffering damage, should the disconnection of the line take too long. Lines on steel pylons require arc-diverting and suppression gear for preventing arcs on the insulator chains of the transposition spans. The paper points out that horn and open-ring arc divertors are better than closed-ring types, and proves this statement in detail.—"The Protective Equipment of H.V. Transmission Lines," G. S. Solodovnikov, *Elektrichestvo*, No. 10, pp. 15–19, October, 1951, in Russian.

Predisposition to Electric Shock

This useful summary of research in several countries deals in the main with the physiological predisposition of the human body to electrical accidents. Very important and regrettable facts are the decrease of the body resistance under electric stress and the low threshold value of the currents capable of doing harm to the human organism. Although there is definitely a "personal factor" varying from one individual to another, 15 mA is certainly the limit at which the muscular spasms set up in the hands still permit the victim to release his hold on a live electrode, but only just.

Supposing the lowest resistance of the body (between hand and foot) to be of the order of 2,000 ohms, this corresponds to a voltage of only 30 V, which proves that in unfavourable conditions even such voltages represent a certain danger. The author mentions a fatal accident at 65 V.

The greater danger of a.c. of commercial frequency is well known, as is also the physiological cause of the decreasing resistance of the body (in the main, the skin) under an applied voltage, i.e., the polarizability of the skin. The role of thermal and electrochemical processes in the reduction of the resistance of the organism is also easy to understand and becomes, among others, evident in the particular character of electrical burns (not to be confused with the so-called "current marks" most noticeable on the victims of lightning strokes). These burns are due to pure internal heat production in the skin, produce blisters, but mostly do not scorch the hair, and thus they cannot be due to external heat effects.

A good case is made out for the generally accepted danger limits of current and voltage, viz., 50 mA and 65 V.—"The Dangers of the Electric Current," I. Kerkoszek, *Österreichische Zeitschrift für Elektrizitätswirtschaft*, Vol. 4, No. 11, pp. 368–372, November, 1951, in German.

Directly Earthed Networks

The Swiss regulations require that where contact voltages of more than 50 V to earth occur, fuses must cut out within less than 5 sec of the occurrence of a short-circuit. This is not achievable with the normal type of fuses, which take up to 10 sec to blow at two and three-quarters times the current rating.

If, on the other hand, fuses of a lower rating are used, the utilization of the current-carrying capacity of the conductor section becomes uneconomic. In this case the use of automatic switches with relays independent of the current is advisable, because the loading of the line may be increased, i.e., the conductor section may be fully utilized, provided an undue voltage drop is avoided.

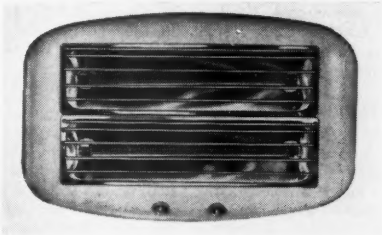
This article presents a simple method of establishing whether the earthed neutral assumes a potential of more than 50 V to earth in the case of a short-circuit between neutral and phase conductor, by measuring the series impedance of transformer phase winding, phase conductor, earthed neutral and, first, a load resistance and, then, a capacitor (or choke) inserted, from which the short-circuit impedance may be calculated or found from a vector diagram. From the impedance of the short-circuited loop the short-circuit current and the contact voltage are easily found and the necessary changes of fuse ratings, etc., determined.—"A Contribution to the Determination of the Contact Voltage and the Short-Circuit Current in Directly Earthed Distribution Systems," W. Keller, *Bulletin Association Suisse des Electriciens*, Vol. 42, No. 21, pp. 837–839, 20th October, 1951, in German.

RECENT INTRODUCTIONS

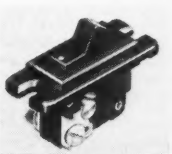
NOTES ON NEW ELECTRICAL AND ALLIED PRODUCTS

Flat-Back Fire

FOLLOWING the recent introduction of the "Creda" 1 kW flat-back reflector fire a 2 kW model has now been made available by the SUNLEX ELECTRIC CO., LTD., Broadwell, Oldbury, Birmingham. Designed for permanent wall mounting without cutting a recess in the wall or plaster, the unit is of attractive design with a cream stove enamel finish and a polished aluminium reflector. It measures 11¾in by 18½in by 4¼in and the price is £4 2s 6d (plus £3 0s 8d purchase tax in this country).



Above: **"Creda" 2 kW flat-back fire.** *Right:* **Taylor insulation tester.** *Below:* **Arrow appliance switch with rocker arm lever**



Appliance Switch

A small appliance switch with a moulded body is now available from ARROW ELECTRIC SWITCHES, LTD., Hanger Lane, Ealing, London, W.5. This compact accessory is rated at 4 A at 250 V or 6 A at 110 V a.c. or d.c. and is fitted with a rocker arm lever which makes it simple to operate.

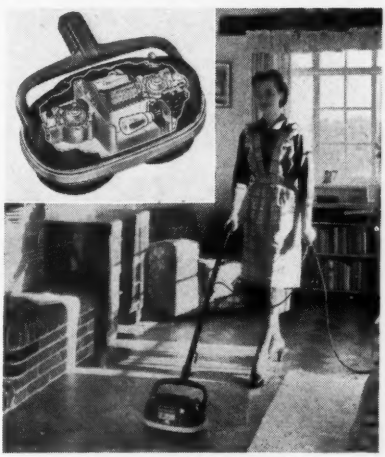
Insulation Tester

The insulation tester Model No. 130A has just been re-introduced by TAYLOR ELECTRICAL INSTRUMENTS, LTD., 419/424, Montrose Avenue, Slough, Bucks. This mains operated ohmmeter covers insulation and medium values of resistance and is suitable for workshop tests or for routine checking of components. A robust moving coil meter is used fitted with a 4in scale and knife edge pointer. Two ranges are provided, the higher covering 200,000 Ω to 1,000 M Ω at a test pressure of 500 V, and the lower covering 20 Ω to 100,000 Ω at a test pressure of 50 mV. A feature of the instrument is the press switch which is fitted for rapidly charging capacitors.

Electric Polisher

An electric polisher brought out by HOOVER, LTD., Perivale, Greenford, Middlesex, is equally effective for wood, linoleum or tiles, and may be used on furniture, a car, walls or any other above-the-floor surface.

A 1/10 h.p. universal motor drives brushes rotating in opposite directions at 650 r.p.m. Felt polishing pads for floors and lambswool polishing pads for furniture clip over the brushes to give an extra gloss. A low-built front, only 6¼in high, makes it possible to polish under low furniture. A 25 W lamp shines through a grille in the front to illuminate



Hoover electric polisher

unpolished places. The polisher is operated by a foot switch and the flex is carried without internal contacts from the motor to the exterior of the handle and thence to the plug. Adequate cooling is provided by an internal ventilating fan.

Although the polisher weighs only 13¼ lb, the aluminium alloy used for the main casting and handle and the reinforced plastic construction of the motor hood ensure durability. An attractive maroon colour has been chosen for the finish. The price is 19 gns (plus £9 14s 6d purchase tax in this country).

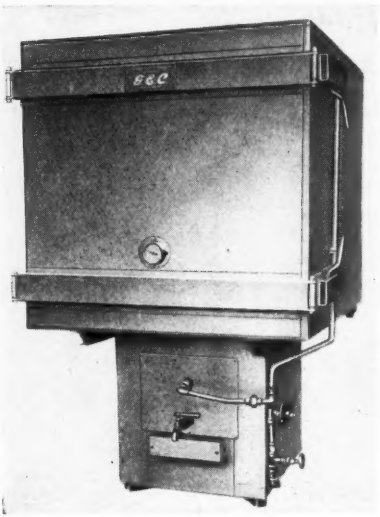
Frequency Meter

An interesting principle is employed in a new frequency meter which is available from the ELECTRICAL INSTRUMENT CO. (HILLINGTON), LTD., Boswell Square, Hillington Industrial Estate, Glasgow, S.W.2. Apart from the moving coil centre zero indicating instrument there is an external reactance box, which is a 5in sided cube containing two a.c. bridge systems. One of these systems balances at or below the lowest frequency and the other at or above the highest frequency to be measured. The outputs of the bridges feed a pair of interconnected instrument rectifiers associated with the indicator.

Sterilizing Chest

A storage block sterilizing chest developed by the GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, London, W.C.2, has been produced with the object of offering a unit of a high design standard and quality yet of low price. This has been achieved by simplifying the construction and by raising the efficiency of steam utilization, which has enabled the lagging around the cabinet to be dispensed with.

G.E.C. storage block type sterilizing chest



The chest is particularly suited for sterilizing steel utensils and milking clusters and when it is packed to the recognized density of 4½ lb of steel utensils per cu ft of capacity it will, in normal circumstances, reach a sterilizing temperature of 210 deg F within 15 minutes. The electrical loading is only 1 kW.

The cabinet is of sheet steel, galvanized after manufacture, and the only projection in the interior is the steam entry pipe. The steam generator incorporates a heavy thermally-insulated cast iron storage block, fitted with heaters of the embedded type, designed to withstand high temperatures. The terminals are outside the heat zone, and ready access from the front is obtainable to all components.

Steam from the generator passes to a 4-way valve, from which it may be directed into the cabinet, or to outlets on either side of the chest. The rate of steaming is controlled by an adjustable valve.

The price of the chest, including a 15-day hand-wound time switch, is £90.

Amplifying and Control Devices

A THREE-DAY symposium of papers on amplifying and control devices was recently held at the research laboratories of Elliott Brothers (London), Ltd., at Borehamwood in which about 120 members of the research and production staff participated.

The purpose was partly tutorial and partly to review a programme of investigation carried out since the laboratories were established in 1946. In fifteen papers, by members of the staff, the basic mechanisms used in measurement and control were reviewed, with attention directed to performance and limiting factors, optimum working conditions and reliability. The papers covered magnetic, thermionic and rotary amplifiers, relays and mechanical, hydraulic and pneumatic devices, and in addition the performances of complete servo systems and computing mechanisms were considered in relation to the concepts of information theory.

The proceedings ended with a general discussion, introduced by the research director, Mr. J. F. Coales, with a brief assessment of each paper in the course of which he stressed its relevance to the company's products and policy, laying particular emphasis on the need for increased reliability and economy in manufacture.

ELECTRICITY SUPPLY

Generation in January

All-Electric Houses at Richmond ?

As most of the new generating plant in an advanced state had been completed in time for inclusion in the December figures, little further addition was expected in January. There was, in fact, no change in the total installed capacity in B.E.A. generating stations, though in the North of Scotland 23 MW was added, thus increasing the aggregate for all areas from 16,328 to 16,351 MW.

	Fuel consumed Thousand tons		kWh generated Millions			kWh sent out Millions	Installed capacity (m.c.r.) MW
	Coal	Oil	Steam	Water power	Total*		
British Electricity Authority ..	3,538	6·7	6,088	67	6,168	5,824	15,711
North of Scotland	16	1·4	23	157	185	183	640
Total for January, 1952	3,554	8·1	6,111	224	6,353	6,007	16,351
Corresponding total for January, 1951	3,434	11·1	5,779	145	5,946	5,628	15,099
Increase or decrease as a percentage of 1951	+3·5	−27·0	+5·7	+54·5	+6·8	+6·7	+8·3

* The total includes 12·9 million kWh generated by oil engines and 4·8 million kWh by waste heat plants in January.

The customary statement of the Ministry of Fuel and Power shows that the B.E.A., the North of Scotland Hydro-Electric Board and the Lochaber Power Co. generated 6,353 million kWh in January. This compares with 5,946 million kWh a year ago, an increase of 6·8 per cent, as shown in the accompanying table.

Uskmouth Power Station

It was stated at a recent meeting of the Welsh Board for Industry's East Wales District Committee that the first 60,000 kW set at the new Uskmouth generating station should be in commission by August and feeding into the grid by the end of the year.

All-Electric Houses

In January Richmond (Surrey) Town Council empowered its Housing Committee to take all steps possible to overcome flue defects in certain dwellings. A proposal to replace the asbestos cement flues by external brick flues was considered, but it was stated that such work would be costly and cause serious disturbance to tenants. As an alternative, a scheme for the electrification of the dwellings was suggested.

The cost of providing a panel radiant fire to cover the flue opening in the living room, a warm air circulator in the kitchen and a hot-water circulator and jacket in the linen cupboard, with the necessary sealing-off and reinstatement, was estimated at £50 per dwelling. From a discussion with the South Eastern Electricity Board it appeared that the additional running cost would be about £30 a year. Against this there would be saved the cost of solid fuel, amounting probably to some £20 for the annual allocation of coal and coke, apart from any unrationed fuel bought.

Having considered the report the Committee recommended the full electrification of the 80 houses concerned at a cost of £4,000. To offset the extra running cost to tenants it felt that the proposed all-round increase in council house rents should not be applied to these houses.

Salisbury Chooses Gas

The question whether gas or electric cookers and wash-boilers should be installed in 350 houses on the Bemerton Heath estate, Salisbury, was recently considered by the Corporation Housing Committee. Electrical appliances, it was estimated, would cost £11,760 and gas equipment £8,773, but if electricity were used only for lighting a contribution of £3,000 was required by the Southern Electricity Board because the income would not warrant the high cost of laying the mains. Therefore the comparable figures would be: electrical appliances, £11,760; gas appliances and electric lighting, £11,773. The Committee recommended in favour of gas equipment, and this was subsequently confirmed by the City Council. Councillor Sanders explained that the Committee felt that as the expenditure was nearly

the same, both gas and electricity services should be available. Although a tenant on entering occupation would find a gas cooker and copper installed, he could, at his own cost, install electrical equipment; to this extent it allowed freedom of choice. In addition, maintenance of gas equipment was much cheaper than repairs to electrical appliances.

Domestic Appliance Maintenance

Because of the cost of maintaining cookers, washing machines, refrigerators and immersion heaters East Grinstead U.D.C. has decided to warn tenants that it may be necessary, if the high expenditure continues, to consider placing the responsibility for paying for repairs on the tenants.

North Wales Scheme

The Merseyside and North Wales Electricity Board has informed the chairman of the Nant Conway R.D.C. that a supply scheme for electricity to Penmachno, near Bettws-y-Coed, is scheduled to be started about June and should be complete in about a year.

School Installations

Cumberland County Council is considering the installation of electricity at Victoria School, Workington, Wilson School, Workington, Gamblesby School, Welton School, Wigton Temporary County School, St. Bees School, Penrith Boys School, and Hesket-Newmarket School.

Termination of Consumers' Agreements

Preparatory to the introduction of standard tariffs, the Yorkshire Electricity Board is sending notices to consumers terminating existing agreements as from 14th June next. The effect is that conditions in agreements and application forms previously issued will be superseded by those laid down in the Electricity (Supply) Acts, 1882 to 1936 and the Electricity Act, 1947.

STREET LIGHTING NOTES

NORTHAMPTON Corporation Highways Committee recommends approval of a revised scheme submitted by the borough engineer for the conversion of the street lighting in the borough from gas to electricity, based on a quotation submitted by the East Midlands Electricity Board. The cost of the scheme is estimated to be £43,383.

WANDSWORTH Borough Council has agreed in principle to the installation of sodium lighting from Brixton Hill to Norbury via Streatham High Road and from Clapham Road to the borough boundary at Mitcham via Balham and Tooting. The cost of the scheme is estimated at £25,755. A similar improvement from Wandsworth Road to Priests Bridge and from Upper Richmond Road to Beverley Brook, costing £25,635, is also contemplated. The new lighting of these four thoroughfares is expected to save £6,892 a year in maintenance charges. An earlier proposal for dealing with all the classified roads at a cost of £160,000 was rejected by the Ministry of Transport.

BRADFORD Corporation Finance Estimates Sub-Committee recommends a scheme for the conversion of several roads from gas to electric lighting at an estimated cost of £29,000, as part of a major plan for changing the city's street lighting.

SUTTON and CHEAM Borough Council is to spend £40,000 on improving street lighting. The first stage of the work is to be started in March.

A scheme for lighting Aldershot Road by mercury vapour or flourescent lamps is being considered by GUILDFORD Town Council.

WEDMORE (Somerset) Council is to negotiate with the South Western Electricity Board for the provision of 82 street lamps.

Provision for alternative levels of illumination has been made in a recent street lighting installation in the Bull Ring, WAKEFIELD, where two of the three fluorescent lamps in the G.E.C. "Three-Eighty" lanterns can be switched off after midnight. Optical control in these lanterns is obtained by means of "Perspex" refractor plates cemented to the inside of the enclosing "Perspex" bowl. The lanterns are mounted at 25ft on concrete columns, at an average spacing of 80ft.

G.E.C. fluorescent lighting at Wakefield

FINANCIAL SECTION

Company Notes and Stock Exchange Activities

Reports and Dividends

The General Electric Co., Ltd., in a circular to ordinary stockholders, states that since the £8,000,000 3½ per cent unsecured loan stock 1954-59 was issued in July, 1949, the company and its subsidiary and associated companies have gone through a period of further expansion and progress. The demand for their products, both at home and overseas, has increased in practically every field they cover, and their commitments under the defence programme are growing daily. This expansion in business requires increased working capital as well as expenditure on new buildings and plant. The directors consider that the further finance required should be raised by the issue of ordinary capital, and they have accordingly decided to offer 1,679,348 ordinary shares of £1 each at 72s 6d per share to ordinary stockholders in the proportion of two new ordinary shares for every £5 ordinary stock held. The net proceeds of the issue will amount to approximately £5,960,000. The new ordinary shares will rank *pari passu* in all respects with the existing ordinary stock, except that they will not participate in the interim dividend of 7½ per cent on the ordinary capital in respect of the year ending 31st March next, which is to be paid on 7th April. The circular states that results for the first nine months of the current financial year have been satisfactory, but the recent increase in the cost of labour and the present general world shortages of raw materials are bound to make themselves felt in the electrical industry. The directors, nevertheless, expect to be able to recommend a final distribution of 15 per cent on the increased ordinary stock in respect of the year ending 31st March next. Morgan Grenfell & Co., Ltd., have agreed, subject to permission to deal and quotation being granted by the Council of the Stock Exchange, to underwrite the issue for a commission of 1s 4½d per share. An extraordinary meeting will be held on 28th February for the purpose of converting the unissued ordinary shares, when issued and fully paid, into ordinary stock.

The Brush Electrical Engineering Co., Ltd., which holds all the issued ordinary capital of the National Gas & Oil Engine Co., Ltd., has now made an offer to acquire all the 600,000 5½ per cent cumulative preference £1 shares of that company, on an exchange basis of eleven Brush 5½ per cent preference for every ten National Gas & Oil Engine preference shares. The offer is conditional upon ratification by holders of not less than 90 per cent of the preference capital (or such less proportion as the Brush Co. may agree to accept), by 8th March (or such later date as may be agreed). It is also conditional upon the Brush Co. increasing its authorized capital to provide sufficient preference shares to implement the agreement. Opportunity is being taken to reorganize the preference capital structure of the Brush Co., which will enable that company in the future to raise further preference capital.

This necessitates an alteration in the articles so that the Brush Co. shall not issue preference shares in excess of £1,800,000 together with an amount equal to three-quarters of the total paid-up ordinary capital issued subsequently to 11th March, 1952, otherwise than on capitalization of profits or reserves, without the sanction of the preference stockholders.

The new Brush preference to be issued in exchange will rank for dividend from 2nd October, 1951, and otherwise will rank *pari passu* with the existing Brush preferences. An extraordinary meeting of the Brush Co. will be held on 11th March to consider the proposals.

Hoover, Ltd.—The annual meeting will be held on 31st March. In his statement circulated to stockholders, Sir Charles Colston (chairman and managing director) says that in 1951 they substantially expanded their business and their growth was greater than at any time in their history. The increase in turnover was about double the turnover in their peak pre-war year. Their expansion during the year took place in the export market, and their exports were about two and a quarter times as large as in 1950. This expansion has been fairly uniform in each of the principal departments—electric cleaners and polishers, electric washing machines and fractional h.p. motors. During 1951 Hoover, Ltd., exported nearly 50 per cent more electric cleaners and 50 per cent more electric washing machines than all other British manufacturers combined. Altogether they are exporting to sixty-six countries. The priority given to exports has involved serious sacrifices in the home market, and he hopes that in working out detailed policy in regard to allocation of materials, the Government will take care to reward and not penalize manufacturers who have heeded its

exhortations in the past to make the maximum effort to expand exports. The demand for their electric cleaners in the home market during 1951 was maintained at a satisfactory level.

Uganda Government Issue.—The lists opened and closed yesterday (Thursday) for an issue of £5,983,000 Uganda Government 3½ per cent stock, 1966-1969 at £89 per cent. Of this amount £1,733,000 has already been placed and £250,000 is reserved for subscription by applicants in East Africa or Zanzibar, leaving £4,000,000 to be subscribed. The proceeds of the issue will be re-lent to the Uganda Electricity Board and be used towards the financing and development of the Owen Falls hydro-electric scheme and connected transmission and distribution services, and for other functions of the Board.

International Combustion (Holdings), Ltd., reports that after providing £724,604 for taxation, the net profit of the group for the year ended 30th September last is £545,189, as compared with £376,235 for the preceding year. It is proposed to pay a final dividend of 17½ per cent (against 15 per cent), making a total distribution for the year of 25 per cent (against 20 per cent).

Hilger & Watts, Ltd., report a net profit for the year to 30th September last, after deducting £56,015 for taxation, of £37,118, as compared with £35,373 for the previous year. The dividend for the year is maintained at 7½ per cent and £36,529 is carried forward (against £19,309 brought in).

Winding-up Petition

Mitchell Electric, Ltd.—A petition for the winding-up of this company has been presented to the High Court by Ashdowns, Ltd., and will be heard in London on 3rd March.

Liquidation

Solar Electric Co., Ltd.—Members' voluntary winding-up. Meeting of members on 17th March at 9, Cavendish Square, London, W.1, to receive an account of the winding-up by the liquidator, Mr. V. A. D. Kent.

Bankruptcies

R. E. Browne, electrical contractor, carrying on business under the style of Browne Brothers at 121, Market Street, Dalton-in-Furness.—Receiving order made 11th February on debtor's own petition.

N. W. Doidge and J. C. Stephenson, formerly carrying on business in partnership as "Doidge & Stephenson" at 16, Coldwell Street, Felling, Durham.—Last day for receiving proofs for dividend 1st Mar[illegible] Trustee, Mr. R. F. Howe, Gibb Chambe[illegible] Westgate Road, Newcastle-on-Tyne, Offi[illegible] Receiver.

J. L. Parker, electrician, 15, West Stre[illegible] Horncastle, Lincs.—First meeting held 1[illegible] February. Public examination 3rd April [illegible] the Guildhall, Lincoln.

G. L. Milton and **A. Coates,** forme[illegible] carrying on business in partnership under t[illegible] style of "Electro Radio," at 44, High Stre[illegible] Buxton.—Last day for receiving proofs f[illegible] dividend 29th February. Trustee, Mr. F. [illegible] Ormrod, 20, Byrom Street, Manchester, [illegible] Official Receiver.

I.D.C. Electrical Appliances, 15-17[illegible] High Street, Hounslow, Middx., electri[illegible]l engineers.—Receiving order made 6th February on a creditor's petition. Fi[illegible]t meeting held 20th February. Public examin[illegible]tion 9th May at the Court House, Half Acre, Brentford, Middx.

J. Hilbert, 17 Manchester Road, Hasling-den, Rossendale, Lancs., radio and electrical engineer.—Receiving order made 6th February on debtor's own petition. First meeting held 19th February. Public examination 25th March at the County Court Buildings, Fleece Street, Rochdale.

F. H. Bell, 21, Queen Street, Kidsgrove, Stoke-on-Trent, formerly carrying on business at 4, Attwood Street, Kidsgrove, Stoke-on-Trent, electrical engineer.—First meeting 23rd February at the Official Receiver's Office, 12, Lonsdale Street, Stoke-on-Trent. Public examination 20th March at the Town Hall, Hanley, Stoke-on-Trent.

W. A. Prince and **C. S. Prince,** carrying on business at 69, Princes Street, Manchester, electrical contractors, trading as Prince Brothers.—Order made 14th January suspending bankrupts' discharges for one day and that they be discharged as from 15th January, 1952.

S. Budge, 153, Cleethorpe Road, Grimsby, Lincs., radio and electrical dealer.—Trustee, Mr. H. S. Bloomer, 8, Flottergate, Great Grimsby, Official Receiver, released 4th February, 1952.

F. F. Chicken, carrying on business at 42-44, Newgate Street, Morpeth, and Biltons Court, Morpeth, Northumberland, radio dealer and electrical contractor.—Trustee, Mr. R. F. Howe, Gibb Chambers, 54, Westgate Road, Newcastle-on-Tyne, Official Receiver, released 5th February, 1952.

C. F. Burns, carrying on business at High Street, Stalham, Norfolk, electrical and radio engineer.—Last day for receiving proofs for dividend 26th February. Trustee, Mr. F. R. D. Walter, Castle Chambers, Opie Street, Norwich, Official Receiver.

STOCKS and SHARES

WITH the Budget so close at hand, a Budget full of unknown possibilities, Stock Exchange business is necessarily proceeding very warily at the present time. A certain amount of selling in advance of the Chancellor of the Exchequer's statement is ascribed to nervousness. On the other hand, the stock which comes to market at what seems to be a low price is not without supporters. The upshot of the present state of affairs is something of a hiatus in activity. Substantial new issues are already with us. Imperial Chemical Industries is offering ten million shares at 40s 6d, and the price started off at about 1s premium. In order to take up their quota some of the allottees have been selling other industrials. The gilt-edged group has been weakened by the advent of a Uganda 3½ per cent loan at 89, which followed closely upon the heels of a Southern Rhodesia 4½ per cent issue at 99. Both are trustee stocks.

G.E.C. New Shares

After opening at 2s 9d, the premium on the new General Electric £1 ordinary shares, offered to shareholders at 72s 6d, hardened to 3s 9d to ease off to 3s 6d. If further evidence were needed about the depressing influence of a new issue in present uneasy conditions, here is another demonstration of it. Despite the general slump in industrials towards the end of last year, G.E.C. shares stood at well over 90s at the beginning of January, and 83s only three weeks ago. Further shillings were knocked off the price as soon as talk of an issue began to circulate, with the result that it was down to 77s 6d by the time this materialized. The "rights" at that level were worth about 1s 6d, so that the subsequent quotation of 76s 3d denoted a steadier tendency. Although not entitled to the 7½ per cent interim dividend just declared for the year ending next month, the new capital ranks for the final which is expected to be 15 per cent on the larger amount. From a total of 22½ per cent, the new ordinary shares at an all-in price of 75s 6d (free of stamp) stand, therefore, to yield about 1s under 6 per cent. All this supports the increasingly wide opinion that these new issue occasions serve to present the best investment opportunities in to-day's phase.

Other Issues

Electric & Musical Industries' new 10s shares have been well supported since their appearance, the premium being firm at around 3s on the issue price of 12s 6d. Automatic Telephone & Electric new £1 ordinary, offered at 45s, retained a premium of 6s 9d, and Associated Electrical Industries new £1 shares recovered to more than 10s premium on 60s, a factor here being the satisfactory news of arrangements to deal with the large "rights" entitlement of the General Electric Company of New York. With an offer from B.I.C.C. pending, it is remarkable how largely the electrical market is monopolizing the new issue news, and it is inevitable that electrical shares should be showing the effects of competition from the attractive yields afforded by several of the newcomers. Automatic Telephone new shares are available on a yield basis of about 6 per cent. On A.E.I. new ordinary, the expected yield is 5¾ per cent, while E.M.I. offer 7¾ per cent. Terms of investment like these can scarcely fail to put pressure on the rest of the market.

Current Profits

One result of the offers of shares made recently by electrical engineering companies has been to give, through the accompanying statements, some idea of current business and earnings in the industry. General Electric's circular explains the need for new working capital and manufacturing plant, by reference to growing demands for its products in practically every field since the issue of £8 million of loan stock about eighteen months ago, and to daily increasing commitments under the defence programme. Results for the first nine months of the year, it is said, have been satisfactory, although labour costs and supply problems are bound to make themselves felt. Statements by the Automatic Telephone and E.M.I. companies both doubted whether the next results would equal the records established last time, but indicated no particular difficulty in maintaining the same rates of dividend as before on larger capital. A.E.I. said that profits in the first ten months of 1951 were a little above those of the same period in the year before. Apart, then, from the unknown factor of E.P.T., these statements are calculated to engender sober confidence in the forthcoming season of industrial dividends and reports.

Price Changes

The changes in prices since a week ago are, for once, not mainly in the downward direction. International Combustion, 21s, and Aron, 36s 3d, are both 1s 3d higher. Perak River, 13s 6d, put on 1s; Great Northern Telegraphs, 10½, are 5s higher; Cossor and Decca are better; and Calcutta Trams hardened to 24s. On the other side of the sheet, Henley's, 17s 6d, have fallen 1s 6d. Johnson & Phillips, 48s 9d, London Electric, 38s 9d, and British Insulated Callender's, 27s, are easier, and in the heavy group Babcock & Wilcox, 65s 9d, show ⅛ fall. Brush Electrical, 57s 6d, are unaffected by the proposal to increase the company's preference capital.

NEXT WEEK'S EVENTS

Monday, 25th February

BIRMINGHAM.—James Watt Memorial Institute, Great Charles Street, 6 p.m. I.E.E. South Midland Radio Group. Address by Dr. D. C. Espley, chairman of the Radio Section, on "Trunk Radio Systems."

Chamber of Commerce, New Street, 7 p.m. Institution of Electronics. "Atomic Energy and Consequences," by Dr. L. E. C. Hughes.

BOURNEMOUTH.—Grand Hotel, Firvale Road, 7.30 p.m. A.S.E.E. Bournemouth Branch. Annual open meeting. "Germanium Crystals," by S. A. Bell.

BRISTOL.—South Western E.B. Offices, Colston Avenue, 6 p.m. I.E.E. Western Utilization Group. Lecture on "Modern Developments in Electric Welding," by Dr. H. G. Taylor.

LEEDS.—At the Lighting Service Bureau, 24, Aire Street, 7 p.m. I.E.S. Leeds Centre. "Electric Lighting—A Contractor's Viewpoint," by J. Ashmore. (Joint meeting with the E.C.A.)

LONDON.—Savoy Place, W.C.2, 5.30 p.m. I.E.E. Radio Section. Debate. "In the Opinion of this House the Lone Worker can no longer make a major Contribution to Radio Development."

NEWCASTLE-ON-TYNE.—Neville Hall, Westgate Road, 6.15 p.m. I.E.E. North-Eastern Centre. "Electricity in Newspaper Printing," by A. T. Robertson.

WARRINGTON.—Carter's Café, Bridge Street, 7 p.m. I.E.E. Mersey and North Wales Centre. District meeting. "Earthing," by P. W. Cave.

Tuesday, 26th February

BRISTOL.—Electricity House, 7 p.m. I.E.E. Bristol Students' Section. "Port Electrical Equipment," by W. S. Evans.

GLASGOW.—At the Institution of Engineers and Shipbuilders, 39, Elmbank Crescent, 7 p.m. I.E.E. Scottish Centre. "The Inductor Compass," by A. Hine.

LONDON.—Savoy Place, W.C.2, 7 p.m. I.E.E. London Students' Section. "An Introduction to High-Voltage Air Blast Circuit Breakers," by D. J. Kingsbury and D. B. Johnston.

At the Royal Society of Tropical Medicine and Hygiene, Manson House, Portland Place, W.1, 7 p.m. Society of Instrument Technology. "Temperature Pocket Lags," by W. Fishwick.

LOUGHBOROUGH.—The College, 6.30 p.m. I.E.E. East Midland Centre. Junior members' night.

MANCHESTER.—Engineers' Club, Albert Square, 7 p.m. I.E.E. North-Western Centre. Annual lecture in co-operation with the Manchester University. "Why Bother About Poetry?" by Prof. H. B. Charlton.

Wednesday, 27th February

BLACKPOOL.—Queen Street Library, 7 p.m. I.E.E. North Lancashire Sub-Centre. District meeting. "Electricity in Newspaper Printing," by A. T. Robertson.

COVENTRY.—At the G.E.C. Telephone Works, 7 p.m. I.E.E. South Midland Students' Section. Informal talk on "Telecommunications in the Midlands," by W. H. Brent, S. Midland Centre Chairman.

LONDON.—Savoy Place, W.C.2, 5.30 p.m. I.E.E. Supply Section. "Performance of Natural Draught Water Cooling Towers," by H. Chilton. (Joint meeting with the Steam Group of the I.Mech.E.)

Waterloo Bridge House, S.E.1, 5 p.m. Institution of Post Office Electrical Engineers. Informal meeting. "Television Interference," by J. S. Hizzey and J. R. Turner.

Connaught Rooms, W.C.2, 12.30 for 12.55 p.m. Batti-Wallahs' Society. Luncheon. Address by Desmond Heap on "The Origin and Development of Local Government."

35, Grosvenor Place, S.W.1, 12 noon. E.A.V. London Branch. Annual general meeting.

WEYMOUTH.—Technical College, 6.30 p.m. I.E.E. Southern Centre. "Review of British Underground Railway Practice," by T. S. Pick and R. Dell.

Thursday, 28th February

LONDON.—Grosvenor House, Park Lane, W.1, 7 for 7.30 p.m. Institution of Electrical Engineers. Annual dinner.

SPALDING.—Corn Exchange, 7.30 p.m. I.E.E. East Midland Centre. District meeting. Informal discussion on "Outdoor Substations up to 11 kV," opened by A. E. Strong.

Friday, 29th February

CAMBRIDGE.—University Arms, 7.15 p.m. I.E.E. East Midland Centre. District meeting. "Domestic Electrical Installations: Some Safety Aspects," by H. W. Swann.

MIDDLESBROUGH.—Town Hall. Electrical Industries Benevolent Association, Tees-Side Area. Annual ball.

OLDBURY.—At Tube Investments Social Club. Electrical Industries Benevolent Association (Birmingham Area). Dance (postponed from 15th February).

Human Relations in Industry

WAYS and means of ensuring the most efficient use of the country's manpower will be discussed at the "Human Relations in Industry" Conference which the Ministry of Labour and National Service is holding at the Institution of Civil Engineers from 18th to 20th March. The Minister, Sir Walter Monckton, will open the Conference and Sir Godfrey Ince, Permanent Secretary of the Ministry, will be the chairman. The subjects to be discussed will include:—Factors affecting the employment of those who want to work—including the older worker and the part-time woman worker; factors which help workers to make the best use of their capacities; factors affecting the physical wastage of manpower; and factors affecting management-worker co-operation and the will to work. Further particulars can be obtained from the Director of Public Relations, Ministry of Labour and National Service, 8, St. James's Square, London, S.W.1.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (2s 8d each including postage) will be obtainable after 2nd April from the Patent Office, 25, Southampton Buildings, London, W.C.2.

194

1[illegible]6. Marconi's Wireless Telegraph Co., Ltd.—Luminescent materials and luminescent discharge devices. 7th October, 1944. (669380.)

1945

12[illegible]5. British Thomson-Houston Co., Ltd.—Electrostatic electron lens structures. 23rd May, 1945. (669381.)

1946

2[illegible]. Wanner, M.—Devices for electro-mechanical power transmission. 3rd January, 1946. (669530.)

7[illegible]. Aughtie, F.—Equipment for use with electrical resistance strain gauges. 12th April, 1947. (Addition to 5[illegible]268.) (669462.)

28038. Watson, W. H., and Guptill, E. W.—Directive antennas for microwaves. 29th August, 1946. (669463.)

28913. Philips Lamps, Ltd.—Electric discharge tubes with focused beams. 27th September, 1946. (669383.)

33513. Telefonaktiebolaget L. M. Ericsson.—Connecting devices for automatic telephone systems. 11th November, 1946. (669384.)

37774. Western Electric Co., Inc.—Multi-cavity magnetron devices. 23rd December, 1946. (669385.)

1947

9991. M-O Valve Co., Ltd., and Warren, G. W.—Thermionic valves. 7th April, 1948. (669386.)

11203. Standard Telephones & Cables, Ltd., and Reeves, A. H.—Electric pulse selecting circuits. 28th May, 1948. (669534.)

19915. British Thomson-Houston Co., Ltd., and Jefferson, H. F.—Soot blowers. 27th August, 1948. (669387.)

21097. British Thomson-Houston Co., Ltd., and Jefferson, H. F.—Control of electrically-operated soot blowers. 9th December, 1948. (669388.)

28125. General Electric Co., Ltd., and Harvey, R.—Thermal storage steam raisers. 14th October, 1948. (669537.)

28144. Naamlooze Vennootschap Philips' Gloeilampenfabrieken.—Radio systems for determining direction for navigation purposes. 21st October, 1947. (669303.)

28258. Western Electric Co., Inc.—Travelling wave amplifier discharge device. 22nd October, 1947. (669473.)

28259. Western Electric Co., Inc.—Coupling of transmission lines having dissimilar impedances. 22nd October, 1947. (Cognate application 28260, 23rd October, 1946). (669471.)

28261. Western Electric Co., Inc.—Travelling wave amplifier discharge device. 22nd October, 1947. (Addition to 669474.) (669475.)

29717. Radio Corporation of America.—Colour television receiver. 7th November, 1947. (669538.)

30828. Radio Corporation of America.—Simultaneous multi-colour television system. 20th November, 1947. 669539.)

32075. British Thomson-Houston Co., Ltd., and Rayden, R. G.—Control of electric motors driving ring spinning machines. 30th November, 1948. (669541.)

1948

5810. Sperry Corporation.—Electrical positional control systems. 26th February, 1948. (669550.)

7887. Patchett, G. N.—Electric supply stabilizing apparatus. 16th March, 1949. (Cognate application 16773, 22nd January, 1948.) (669306.)

9356. British Thomson-Houston Co., Ltd., Anderson, J. T., and Ward, H. F.—Process for coating vitreous surfaces with powdered luminescent materials. 29th April, 1949. (669392.)

12400. British Thomson-Houston Co., Ltd.—Regulators for alternators. 5th May, 1948. (669520.)

16662. Jacoby, G.—Electric photographic exposure meters. 21st June, 1948. (Convention date not granted.) (669393.)

18915. General Electric Co., Ltd., Nelson, E. H., and Willoughby, A. H.—Arrangements for operating an electric discharge lamp from a d.c. supply. 26th January, 1950. (669285.)

23899. Telefon Fabrik Automatic Aktieselskabet, and Ungar, E.—Coin control circuits for telephone systems. 10th September, 1948. (669285.)

25101. Schulmeister, L.—X-ray apparatus. 27th September, 1948. (669395.)

30154. Communications Patents, Ltd., and Bazin, R. E.—High-frequency electric field seam welding or bonding of dielectric sheet materials. 19th December, 1949. (669318.)

30608. Motorola, Inc.—Modulation system. 25th November, 1948. (Cognate application 30609, 2nd April, 1948.) (669320.)

31249. British Thomson-Houston Co., Ltd., and Stent, T. F.—Suction cleaners. 16th November, 1949. (669558.)

32371. Lignes Télégraphiques et Téléphoniques.—Processes for manufacturing magnetic materials for use at high frequencies constituted by very thin magnetic wires electrically insulated from one another. 14th December, 1948. (Cognate application 32372, 14th October, 1948.) (669322.)

32951. Western Electric Co., Inc.—Semi-conductive alloys and devices utilizing them. 21st December, 1948. (669399.)

1949

86. British Thomson-Houston Co., Ltd.—Controls for electric blankets and the like. 3rd January, 1949. (669400.)

493. Western Electric Co., Inc.—Electrical signalling systems. 7th January, 1949. (669401.)

872.—Automatic Electric Laboratories, Inc.—Key sender circuit. 12th January, 1949. (669522.)

958. Cinema-Television, Ltd., and Johnson, L. R. J.—Television and like cameras. 6th December, 1949. (669523.)

2181. General Electric Co., Ltd., Lane, R. J., and Rycroft, J. L.—Thermal storage steam raisers. 26th January, 1950. (669564.)

3059. Lignes Télégraphiques et Téléphoniques.—Power supply systems for telecontrolled repeater stations in coaxial line telecommunication circuits. 3rd February, 1949. (Cognate application 3060, 14th June, 1948.) (669534.)

3665. Imperial Chemical Industries, Ltd., Chadwick, R., and Heaton, W. G.—Electrolytic processes. 10th February, 1950. (669335.)

4154. Telegraph Construction and Maintenance Co., Ltd.—Electric cables. 16th March, 1950. (669404.)

4270. British Thomson-Houston Co., Ltd., and Griffiths, L.—Speed indicating devices with electric generators. 5th December, 1949. (Addition to 627351.) (669480.)

4812. British Thomson-Houston Co., Ltd.—Magnetic material in single crystal form. 22nd February, 1949. (669289.)

4836. Kassen-Aufzugs-und Maschinen-Bau Akt.-Ges. F. Wertheim & Co.—Electrical plant. 22nd February. 1949. (669407.)

5604. **Metropolitan-Vickers Electrical Co., Ltd., and Bradshaw, E.**—Apparatus for the measurement of rate-of-change of frequency of alternating currents. 23rd February, 1950. (669409.)

5700. **Sturtevant Engineering Co., Ltd., Wagner, H. W., and Guelikman, M.**—Electrostatic precipitators. 16th March, 1950. (669410.)

5890. **British Broadcasting Corporation, Peachey, F. A., and Gunn-Russell, C.**—Apparatus for comparing unidirectional voltages. 3rd March, 1950. (669481.) 6489. Apparatus for monitoring the transmission of electric signals. 8th March, 1950. (669483.)

7484. **General Electric Co., Ltd., and Harvey, R.**—Thermal storage steam raisers. 14th October, 1948. (Divided out of 669537.) (669569.)

7714. **Automatic Telephone & Electric Co., Ltd.**—Impulse-responding circuits for use in telephone or like signalling systems. 9th March, 1950. (669412.)

8056. **Philips Electrical, Ltd.**—Magnet cores for electromagnetic devices. 24th March, 1949. (669571.)

8744. **Pye, Ltd., and Fisher, D. H.**—Tuning arrangement for television receivers. 30th March, 1950. (669292.)

8828. **Soc. d'Exploitation de Brevets.**—Dynamo-electric machines. 31st March, 1949. (Cognate application 8829, 11th March, 1949.) (669573.)

9299. **English Electric Co., Ltd.**—Electric transmission systems for vehicles. 5th April, 1950. (669576.)

9445. **McCrone, S. G.**—Electric contact maker or switch suitable for use on public service vehicles. 18th January, 1950. (669293.)

9592. **Sperry Corporation.**—Electrical control systems for controlling the position or orientation of an apparatus unit. 26th February, 1948. (Divided out of 669550.) (669577.)

9775. **British Thomson-Houston Co., Ltd.**—Electromagnetic devices. 11th April, 1949. (669347.)

9892. **Radio Corporation of America.**—Storage tube. 12th April, 1949. (669414.)

10886. **Telegraph Condenser Co., Ltd.**—Leading-out wires for electrical apparatus. 25th April, 1950. (669580.)

11088. **General Electric Co., Ltd., and Smith, R.**—High-frequency electric inductors. 26th April, 1950. (669350.)

11130. **Birlec, Ltd., and Harris, J.**—Convection furnaces. 27th July, 1950. (669351.)

11216. **Bowlus, C. A.**—Machine for inductively welding seams. 27th April, 1949. (669352.)

11326. **British Thomson-Houston Co., Ltd.**—Clamps for magnetic cores formed of stacked laminations. 28th April, 1949. (669296.)

11806. **Hazeltine Corporation.**—Self-quench super regenerative amplifier. 3rd May, 1949. (669486.)

12451. **British Thomson-Houston Co., Ltd.**—Production of polymers of 3-vinylpyrene. 10th May, 1949. (669487.)

12598. **Claesson, P. H. E., and Johansson, K. L.**—Capacity-operated indicating or warning systems. 11th May, 1949. (669359.)

12915. **Electric & Musical Industries, Ltd.**—Scanning circuit arrangements for television and like apparatus. 18th April, 1950. (669419.)

13120. **Zenith Radio Corporation.**—Coded electrical signal transmitters. 17th May, 1949. (669582.)

13121. **Zenith Radio Corporation.**—Coded electrical signal receivers. 17th May, 1949. (669583.)

13402. **Philips Electrical, Ltd.**—Switches, more particularly selectors for automatic telephone systems. 19th May, 1949. (669361.)

13441. **Westinghouse Electric International Co.**—Radiation-emitting screens. 19th May, 1949. (669584.)

13723. **Dehn, S. G.** (Automatic Electric Laboratories Inc.).—Test boards for telephone systems. 23rd May 1949. (669422.)

14048. **Libois, L. J.**—Electric pulse modulation systems. 25th May, 1949. (669364.)

14458. **Communications Patents, Ltd., and Spooner D. J.**—Apparatus employing electronic valve devices. 21st April, 1950. (669524.)

15052. **Premier Electric Heaters, Ltd., Parker, A. J., Taylor, H. T., and Collins, G. H.**—Electric resistance heating elements and their manufacture. 5th June, 1950. (669490.)

15053. **Premier Electric Heaters, Ltd., and Taylor, H. T.**—Electric resistance heating elements. 5th June, 1950. (669491.)

16827. **Reyrolle & Co., Ltd., A., and Edgley, R.**—Electric protective arrangements. 23rd June, 1950. (669595.)

18329. **Philips Electrical, Ltd.**—High-frequency transformers for the transmission of electric impulses. 12th July, 1949. (669596.)

23170. **Standard Telephones & Cables, Ltd., Fortescue, C. H., and Klepp, G. F.**—Electric discharge tubes. 7th September, 1949. (669427.)

23436. **M-O Valve Co., Ltd., and Dix, J. C.**—Single cavity resonator interdigital magnetrons. 11th September, 1950. (669377.)

25510. **Parmiter, Hope & Sugden, Ltd.**—Electrical fuses of the bi-metallic type. 22nd September, 1950. (669378.)

25977. **Ceag, Ltd., and Plummer, R. J.**—Electric storage batteries. 26th September, 1950. (669601.)

26492. **London Electrical Manufacturing Co., Ltd., and Vaudin, L. N.**—Electrical condensers. 20th December, 1950. (Cognate application 8916. 11th April, 1950.) (669435.)

26645. **Bendix Aviation Corporation.**—Winding-arrangement for variable transformer. 17th October, 1949. (669436.)

28524. **Philips Electrical, Ltd., and Latimer, K. E.**—High-frequency electric transformers for the transmission of electric impulses. 7th November, 1949. (Addition to 669596.) (669603.)

30294. **Akt.-Ges. Kummler & Matter.**—Rod-shaped conductor or insulator elements for overhead lines of electrically operated vehicles. 25th November, 1949. (669606.)

30488. **Metropolitan-Vickers Electrical Co., Ltd.**—Air or gas pressure-reducing devices. 23rd November, 1950. (669448.)

31064. **Touzel, G. R.**—Methods and apparatus for generating high-frequency current, in particular for medical purposes. 2nd December, 1949. (Cognate application 31065, 17th November, 1949.) (669450.)

1950

592. **Brooke, W., and Baldwin, H. T.**—Remote control and protection of electric motors. 10th January, 1950. (669607.)

1702. **Centre National de la Recherche Scientifique.**—Electrostatic machines. 23rd January, 1950. (669454.)

1960. **Western Electric Co., Inc.**—Arrangements for reducing distortion in electric signals. 25th January, 1950. (669455.)

2385. **British Thomson-Houston Co., Ltd.**—Alumina-containing phosphors. 30th January, 1950. (669457.)

2518. **Aksjeselskapet Proton.**—Core for electromagnets. 31st January, 1950. (669458.)

3363. **Westinghouse Brake & Signal Co., Ltd., Jenkins, A., and Peter, L. H.**—Manufacture of dry surface contact rectifiers. 27th July, 1950. (669611.)

5070. **Western Electric Co., Inc.**—Modulator circuits. 28th February, 1950. (669223.)

5747. **Compagnie pour la Fabrication des Compteurs et Matériel d'Usines à Gaz.**—Systems of centralized remote control by carrier currents superimposed on electrical energy distribution networks. 7th March, 1950. (669224.)

6558. **Wanner, M.**—Devices for electro-mechanical differential power transmission with continuous change of speed by means of an auxiliary variable frequency. 3rd January, 1946. (Divided out of 669530.) (669616.)

7016. **Standard Telephones & Cables, Ltd.**—Electric pulse code modulation systems. 21st March, 1950. (669617.)

10177. **Elektrokemisk Aktieselskapet.**—Continuous self-baking electrodes. 25th April, 1950. (Addition to 659509.) (669507.)

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

When "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses.

Australia.—MELBOURNE.—5th March. Victorian Railways Commissioners. Supply of two miles of telephone cable. (C.R.E. 5320/52. Ten/3612.)*

19th March. State Electricity Commission of Victoria. Driving motors and starting equipment for test alternator installation. (C.R.E. 5375/52. Ten/3611.)*

Denbighshire. — County Education Authority. Electrical installation at proposed new primary school at Abergele. (See this issue.)

Egypt. — CAIRO. — 5th March. Director General, Cairo Electricity and Gas Administration. Supply of sixty 300 kVA, forty 150 kVA and ten 400 kVA power transformers. (See this issue.)

Horwich.—1st March. U.D.C. Tungsten and sodium lamps for one year. T. Roscoe, clerk, Council Offices.

India.—NEW DELHI.—26th March. Directorate General of Supplies and Disposals. Supply of cable. (C.R.E. 532/52. Ten/3601.)* 18th March. Portable electric arc welding sets. (C.R.E. 5218/52. Ten/3610.)*

New Zealand.—WELLINGTON.—5th March. Post and Telegraph Department. Supply of cartridge fuses. (C.R.E. 5439/52. Ten/3597.)* 5th March. Director General (Stores Division) G.P.O. Supply of cotton sleeving, silk tape and electrical adhesive tape. (C.R.E. 5438/52. Ten/3690.)* 18th March. Supply of copper wire. (C.R.E. 5440/52. Ten/3608.)*

Nigeria.—LAGOS.—Electricity Corporation of Nigeria. Supply and erection of 132 kV transmission lines. (See this issue.)

Portugal.—LISBON.—29th March. Directorate General of Hydraulic Services. Electrical and mechanical equipment for the power stations of the hydro-electric and hydro-agricultural schemes of the Island of Teceira (Azores). (C.R.E. 4056/52. Ten/3591.)*

Rowley Regis.—3rd March. Town Council. Electricians' requisites for one year. Town clerk, Municipal Buildings, Old Hill, Staffs.

Sheffield. — 10th March. City Council. Pumps with motors, switchgear, etc., for sewage pumping station at Low Edges. City engineer, Town Hall.

South Africa.—JOHANNESBURG.—6th March. South African Railways. Supply of 500 accumulators of 2 V, 27 Ah capacity, 500 accumulators of 2 V, 60 Ah capacity, 100 table telephones and 250 wall telephones. (C.R.E. 5581/52. Ten/3604.)*

Uruguay. — MONTEVIDEO. — 5th March. Administracion Municipal de Transportes Colectivos. Plates for batteries. (C.R.E. 4590/52. Ten/3594.)*

Walthamstow.—19th March. Corporation. Public address equipment for Lloyd Park Pavilion. (See this issue.)

*Specifications may be inspected at the Commercial Relations and Exports Department, Board of Trade, Horse Guards Avenue, Whitehall, S.W.1 (Trafalgar 8855).

ORDERS PLACED

Dudley.—Housing Committee. Installation of electricity in a further 224 Council houses (£5,064).—T. R. Priest & Sons, Ltd.

Gateshead.—Education Committee. Electrical installation for stage two of new technical college scheme (£11,232).—Robson & Coleman, Ltd. Electrical installation at Southend Road Junior School (£5,340).—A. F. Jemison.

Glendale (Northumberland). — R.D.C. Electrical installations in 64 houses at High Fair, Wooler.—N. Young.

Maidstone.—Housing Committee. Re-wiring and replacing all electrical fittings in 34 Council houses in Queen's Road (£1,426).—Horton, Goodchild & Co., Ltd.

South Shields. — Education Committee. Electric water heaters for schools (£1,805).—Ramsay & Son.

York. — Corporation Housing Committee. Electrical installations in 220 houses at Moor Lane (£6,307) and in 200 houses on the Askham Lane estate (£5,767).—R. T. Checksfield.

CONTRACTS IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Abercarn.—Pithead baths, Celynen Colliery, for National Coal Board; W. & A. Davies, Ltd., builders, Abersychan.

Accrington. — Shops and flats, Ferngore Avenue (£17,083); Leonard Frankland, Ltd., builders, Blackburn Road, Church.

Birkenhead.—Factory, Corporation Road; Victory-Kidder Printing Machine Co., Ltd., Laird Street.

Cheltenham.—Flats (204), Arle and Hesters Way estate; Louis de Soissons, architects, 3, Park Square Mews, N.W.1.

Chester.—Drill hall and offices, Tower Wharf; Cheshire T. & A.F Association, 1, Grey Friars.

Clatterbridge. — Ear, nose and throat department at hospital for Liverpool Regional Hospital Board; regional architect, 88, Church Street, Liverpool.

Coventry. — New junior department at Limbrick Wood Primary School; Gilbert Ash, Ltd., 2, Stanhope Gate, London, W.1.

T.A. centre at Greens Road, Keresley, Coventry; F. B. Andrews & Son, architects, 95, Colmore Row, Birmingham.

Croydon. — Additional factory; Bowater's Fibre Containers, Ltd., Purley Way.

Dagenham.—Civic restaurant, Goresbrook (£13,500); E. J. Soule & Co., builders, Main Road, Romford.

Durham. — Additions to Chopwell West County, Consett County Infants', Sacriston County Boys' and Infants', and Wingate A. J. Dawson Grammar Schools; county architect, Court Lane, Durham.

Ellesmere Port.—Civic hall for U.D.C.; Wm. Tomkinson & Sons, Ltd., 3, Great Newton Street, Liverpool.

Exeter.—Dwellings (44), Vaughan Road, and 50 at Beacon Lane site; city surveyor, 7, Southernhay West.

Fleetwood.—Houses (82), West View estate; Brown and Jackson, Ltd., builders, Elm Street, Fleetwood.

Gateshead.—Houses (58), Durham Road and houses and flats at Wrekenton; H. J. Cook, chief architect, Municipal Buildings.

Grantham.—Houses (33) for Town Council; Rudd & Son, Ltd., Wharf Road.

Halesowen.—Houses (20) at Howley Grange estate; Samuel Parkes (Builders), Ltd., Powke Lane, Blackheath, Birmingham.

Hemel Hempstead.—Houses (148), Honshell Wood, for Development Corporation; C. E. Culpin & Partners, architects, 3, Southampton Place, London, W.C.1.

Hemsworth. — Office building, Westfield Road, for Ministry of National Insurance; Henry Field & Son, Ltd., builders, Stairfoot, Barnsley.

Keighley.—Stage 1 of new technical college (to commence 1st May); county architect, Wakefield.

Lancashire.—Hostels for aged persons on sites at Leigh and Golborne (£85,710); county architect, County Offices, Preston.

Leicester.—Secondary modern school (640 places), New Parks estate; city education offices, Newark Street.

Liverpool.—Large new showrooms and offices at 40/42 Lord Street; North & Partners, architects, Queen Street Chambers, Maidenhead, Berks.

Additional classrooms at Rudston Road C.P. School; Marshall Bros. (Builders), Ltd., 3/5, Salop Street, Liverpool.

London. — KENSINGTON. — Rebuilding St. Charles' R.C. Primary School; Nicholas & Dixon-Spain, architects, 19, Hanover Square, W.1.

STEPNEY. — Reconstruction of Pathological Laboratory at Mile End Hospital; Dowton & Hurst, architects, 72, New Cavendish Street, W.1.

Middlesbrough.—New library at Thorn[illegible]e (£9,000); borough engineer.

Houses (36) for Egerton Price; Garl[illegible]t, Archibald & Archibald, Albert Road.

Northampton.—Villas for women patie[illegible]s, St. Crispin Hospital (£66,598); Oxford Regi[illegible]al Hospital Board, 43, Banbury Road, Oxford.

North Shields.—Factory addition, G[illegible]-cester Road for Torday, Ltd.; G. H. G[illegible], architect, Camden Street.

Norwich. — Dwellings (152), North [illegible]k Avenue site; city architect, City Hall.

Oakham.—Junior and infants' school, [illegible]r Rutland C.C.; W. Rosser, architect, 20, D[illegible]n-gate, Northampton.

Oldham.—Houses and bungalows (90), Fi[illegible]n Hill estate; Unit Construction Co., Ltd., Kn[illegible]s-ford.

Poole.—Showrooms and workshops; Ho[illegible]e-stead Garages, Ringwood Road, Parkstone.

Portsmouth.—Houses (116), Paulsgrove; city architect.

Laboratory and offices at Naval Resea[illegible]ch Station; R. J. Winnicott, Ltd., builders, Copnor Road.

Richmond (Yorks).—Houses (150) north of Darlington Road; borough engineer.

Salford.—Additional classrooms at Stott Lane, Pendleton; Halliday & Agate, architects, 14, John Dalton Street, Manchester.

Flats (66) at Islington Street; Unit Construction Co., Ltd., Knutsford, Ches.

Salisbury.—Flats (28), Bemerton Heath; city engineer, Council House, Bourne Hill.

Sedgefield.—Houses (350) including 200 for miners; surveyor to Rural Council, Sedgefield, Durham.

Sedgley.—Flats (28) at Moden Hill site for U.D.C.; Wm. Whittingham, Ltd., Powlett Street, Wolverhampton.

Sheffield.—Secondary modern boys' school, Hurlfield; Gollins, Melvin & Partners, architects, 21, Russell Square, London, W.C.1.

Skegness.—Houses (38), St. Clement's estate; Ivor M. Cule, clerk, Town Hall.

Smethwick.—Three blocks of four-storey dwellings at Broomfield and South Road site; borough engineer.

New bay at works; Henry Hope & Sons, Ltd., Halford Works.

South Shields.—Additions to the Town Hall (£125,000); borough engineer.

Truro.—Houses (32), on six sites; J. H. Snellgrove, 26, Coinagehall Street, Helston.

Tutbury.—Houses (49), Church Lane, Barton-under-Needwood; R.D.C. surveyor.

Wallsend.—Flats (104) (£127,010); borough surveyor.

Walsall. — Transport Department garage; M. E. Habershon, borough engineer.

Winchester.—School of Arts and Crafts; county architect, The Castle.

Windsor.—Houses (238), Clewer Hill Road; borough engineer.